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UNITED STATES PATENT APPLICATION

FOR

DIARYLCYCLOALKYL DERIVATIVES, PROCESSES FOR THEIR PREPARATION AND THEIR USE AS PHARMACEUTICALS

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CROSS-REFERENCE TO RELATED APPLICATIONS

[001] The present application is a continuation in part of U.S. Patent Application No. 10/231,432. The present application claims priority under 35 U.S.C. § 119 of German Application Nos. 10142734.4 and 10223273.3, filed August 31, 2001 and May 24, 2002, respectively, the disclosures of which are expressly incorporated by reference herein.

DESCRIPTION

Field of the Invention

[002] The invention relates to diarylcycloalkyl derivatives and to their physiologically acceptable salts and physiologically functional derivatives.

Background of the Invention

[003] Compounds of similar structure have already been described in the prior art for the treatment of hyperlipidemia and diabetes (PCT/US00/11490).

SUMMARY OF THE INVENTION

[004] An object of the invention is to provide compounds having a therapeutically exploitable triglyceride-lowering action and a favorable effect on lipid and carbohydrate metabolism, such as for syndromes of dyslipidemias, type II diabetes and the metabolic syndrome/syndrome X. Another object of the invention is to provide compounds having improved action compared with the compounds of PCT/US00/14490. The compounds of the invention may activate the PPARα receptor.

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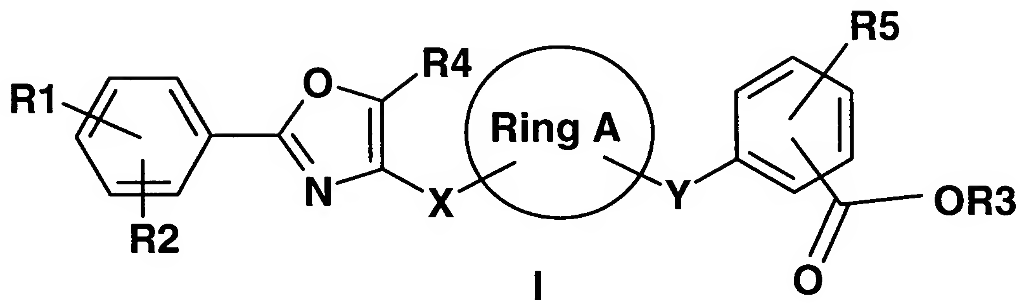
[005] In one aspect, the present invention is directed to a compound of formula I



I

in which

Ring A is (C_3-C_8)-cycloalkyl or (C_3-C_8)-cycloalkenyl where, in the cycloalkyl or cycloalkenyl rings, one or more carbon atoms may be replaced by oxygen atoms;

R1, R2, R4, R5 independently of one another are H, F, Cl, Br, OH, NO_2, CN, CF_3, OCF_3, (C_1-C_6)-alkyl or O-(C_1-C_6)-alkyl;

R3 is H or (C_1-C_6)-alkyl;

X is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

Y is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

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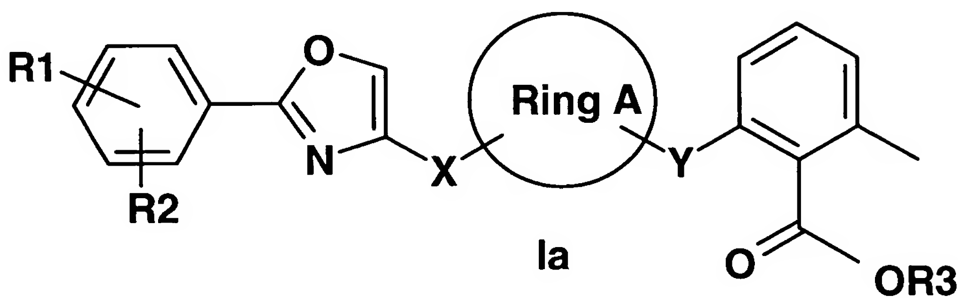
and its physiologically acceptable salts.

[006] In another aspect, the present invention is directed to a compound of formula Ia



Ia

wherein

Ring A is cyclohexyl;

R1, R2 independently of one another are H, F, Cl, Br, OH, NO_2, CN, CF_3, OCF_3, (C_1-C_6)-alkyl or O-(C_1-C_6)-alkyl;

R3 is H or (C_1-C_6)-alkyl;

X is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

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Y is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

and its physiologically acceptable salts.

[007] In another aspect, the present invention is directed to a pharmaceutical, comprising at least one of the above compounds or physiologically acceptable salts and a pharmaceutically acceptable carrier.

[008] In still another aspect, the present invention is directed to a pharmaceutical, comprising at least one of the above compounds or physiologically acceptable salts, at least one further active compound, and a pharmaceutically acceptable carrier.

[009] In yet another aspect, the present invention is directed to a pharmaceutical, comprising at least one of the above compounds or physiologically acceptable salts, at least one lipid- or triglyceride-lowering active compound, and a pharmaceutically acceptable carrier.

[010] The present invention is also directed to a method of treating a lipid metabolism disorder, type II diabetes, syndrome X, disturbed glucose tolerance, eating disorders, obesity, cardiomyopathy, cardiac insufficiency, osteoporosis, atherosclerosis, Alzheimer's disease, or inflammation, comprising administering to a host in need of such treatment an effective amount of at least one the above compounds or physiologically acceptable salts.

[011] In another aspect, the present invention is directed to a method of treating a lipid metabolism disorder, type II diabetes, or syndrome X, comprising

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administering to a host in need of such treatment an effective amount of a combination of at least one of the above compounds or physiologically acceptable salts and at least one further active compound.

[012] In another aspect, the present invention is directed to a process for preparing a pharmaceutical, comprising mixing at least one of the above compounds or physiologically acceptable salts with a pharmaceutically acceptable carrier to form a mixture and bringing this mixture into a form suitable for administration to form the pharmaceutical.

DESCRIPTION OF THE INVENTION

[013] The particulars shown herein are by way of example and for purposes of illustrative discussion of the various embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

[014] Unless otherwise stated, a reference to a compound or component, includes the compound or component by itself, as well as in combination with other compounds or components, such as mixtures of compounds.

[015] The invention relates to compounds of formula I

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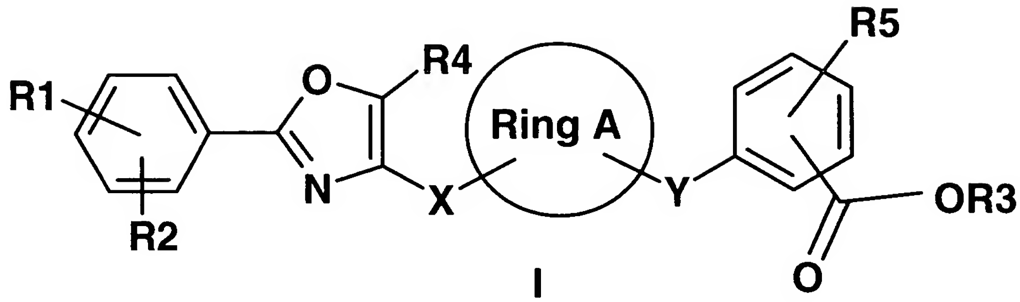

I

in which

Ring A is $(C_3\text{-}C_8)$-cycloalkyl or $(C_3\text{-}C_8)$-cycloalkenyl where, in the cycloalkyl or cycloalkenyl rings, one or more carbon atoms may be replaced by oxygen atoms;

R1, R2, R4, R5 independently of one another are H, F, Cl, Br, OH, NO_2, CN, CF_3, OCF_3, $(C_1\text{-}C_6)$-alkyl or O-$(C_1\text{-}C_6)$-alkyl;

R3 is H or $(C_1\text{-}C_6)$-alkyl;

X is $(C_1\text{-}C_6)$-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

Y is $(C_1\text{-}C_6)$-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

and their physiologically acceptable salts.

[016] The invention also includes compounds of formula I in which

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Ring A is (C_3-C_8)-cycloalkyl or (C_3-C_8)-cycloalkenyl where, in the cycloalkyl or cycloalkenyl rings, one or more carbon atoms may be replaced by oxygen atoms;

R1, R2, R4 independently of one another are H, F, Cl, Br, OH, NO_2, CN, CF_3, OCF_3, (C_1-C_6)-alkyl or O-(C_1-C_6)-alkyl;

R5 is (C_1-C_6)-alkyl;

R3 is H or (C_1-C_6)-alkyl;

X is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

Y is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

and their physiologically acceptable salts.

[017] The invention further includes compounds of formula I in which

Ring A is (C_3-C_8)-cycloalkyl or (C_3-C_8)-cycloalkenyl;

R1, R2 independently of one another are H, F, Cl, Br, OH, NO_2, CN, CF_3, OCF_3, (C_1-C_6)-alkyl or O-(C_1-C_6)-alkyl;

R3 is H or (C_1-C_6)-alkyl;

X is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

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Y is (C_1-C_6)-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

and their physiologically acceptable salts.

[018] One embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A is (C_3-C_8)-cycloalkyl ;

R1, R2, R4, R5, independently of one another, are H, F, Cl, Br, CF_3, OCF_3, CN, CH_3, or OCH_3;

R3 is H or CH_3;

X is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom;

Y is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[019] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A is cyclohexyl;

R1, R2 are, independently of one another, H, F, Cl, Br, CF_3, OCF_3, CN, CH_3, or OCH_3;

R3, R4, R5 are, independently of one another, H or CH_3.

X is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and

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Y is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[020] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A is cyclohexyl;

R1 is H, CH_3, or OCH_3;

R2 is H, F, Cl, Br, CF_3, OCF_3, CN, CH_3, or OCH_3.

R3, R4, R5 are, independently of one another, H or CH_3.

X is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and

Y is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[021] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A is cyclohexyl;

R1, R3, R4, are, independently of one another, H;

R2 is H, F, Cl, Br, CF_3, OCF_3, CN, CH_3, or OCH_3;

R5 is CH_3.

X is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and

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Y is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[022] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A	is cyclohexyl;
R1, R3	are, independently of one another, H;
R2	is H, F, Cl, Br, CF_3, OCF_3, CN, CH_3, or OCH_3;
R4	is CH_3; and
R5	is CH_3.
X	is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and
Y	is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[023] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A	is cyclohexyl;
R1	is H, CH_3, or OCH_3;
R2	is H, F, Cl, CF_3, OCF_3, CH_3, or OCH_3;
R3	is H;
R4	is H or CH_3; and
R5	is CH_3;

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X is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and

Y is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[024] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A is cyclohexyl;

R1 is H or CH_3;

R2 is F, OCF_3, CH_3, or OCH_3;

R3 is H;

R4 is H or CH_3; and

R5 is CH_3;

X is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and

Y is $(C_1\text{-}C_2)$-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[025] Another embodiment of the invention relates to the compounds of formula I and their physiologically acceptable salts in which:

Ring A is cyclohexyl;

R1 is H;

R2 is F, OCF_3, CH_3, or OCH_3;

R3 is H;

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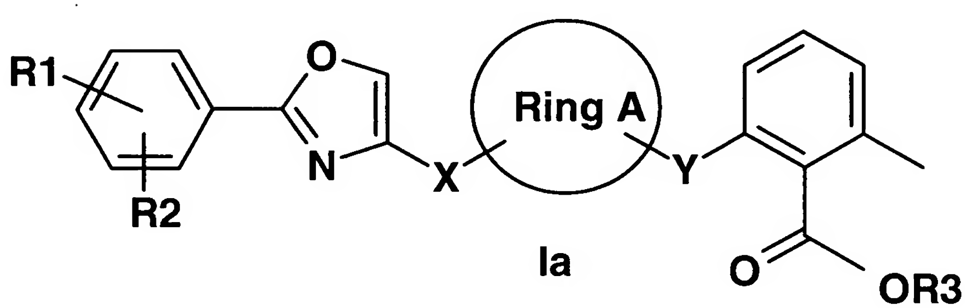
R4	is H or CH_3; and
R5	is CH_3;
X	is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom; and
Y	is (C_1-C_2)-alkyl where, in the alkyl group, one carbon atom is replaced by an oxygen atom.

[026] The invention also includes compounds of formula Ia



Ia

wherein

Ring A	is cyclohexyl;
R1, R2	independently of one another are H, F, Cl, Br, OH, NO_2, CN, CF_3, OCF_3, (C_1-C_6)-alkyl or O-(C_1-C_6)-alkyl;
R3	is H or (C_1-C_6)-alkyl;

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X is $(C_1\text{-}C_6)$-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

Y is $(C_1\text{-}C_6)$-alkyl where, in the alkyl group, one or more carbon atoms may be replaced by oxygen atoms;

and their physiologically acceptable salts.

[027] The invention embraces compounds of formula I in the form of their racemates, racemic mixtures and pure enantiomers, and also their diastereomers and mixtures thereof.

[028] The alkyl radicals in the substituents R1, R2, R3, R4 and R5 can be straight-chain or branched.

[029] Pharmaceutically acceptable salts are suitable for medical applications because of their greater solubility in water compared with the starting or base compounds. These salts must have a pharmaceutically acceptable anion or cation. Suitable pharmaceutically acceptable acid addition salts of the compounds of the invention are salts of inorganic acids such as hydrochloric acid, hydrobromic, phosphoric, metaphosphoric, nitric and sulfuric acids, and of organic acids such as, for example, acetic acid, benzenesulfonic, benzoic, citric, ethanesulfonic, fumaric, gluconic, glycolic, isethionic, lactic, lactobionic, maleic, malic, methanesulfonic, succinic, p-toluenesulfonic and tartaric acids. Suitable pharmaceutically acceptable basic salts are ammonium salts, alkali metal salts (such as sodium and potassium salts) and alkaline earth metal salts (such as magnesium and calcium salts).

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[030] Salts with a pharmaceutically unacceptable anion such as, for example, trifluoroacetate likewise belong within the scope of the invention as useful intermediates for the preparation or purification of pharmaceutically acceptable salts and/or for use in nontherapeutic, for example *in vitro*, applications.

[031] The term "physiologically functional derivative" used herein refers to any physiologically tolerated derivative of a compound of formula I of the invention, for example, an ester which is able, on administration to a mammal such as, for example, a human, to form (directly or indirectly) a compound of formula I or an active metabolite thereof.

[032] Physiologically functional derivatives also include prodrugs of the compounds of the invention, as described, for example, in H. Okada *et al.*, Chem. Pharm. Bull. 1994, 42, 57-61. Such prodrugs can be metabolized *in vivo* to a compound of the invention. These prodrugs may themselves have activity or not.

[033] The compounds of the invention may also exist in various polymorphous forms, for example as amorphous and crystalline polymorphous forms. All polymorphous forms of the compounds of the invention belong within the scope of the invention and are a further aspect of the invention.

[034] All references hereinafter to "compound(s) of formula I" refer to compound(s) of formula I as described above, and to the salts, solvates and physiologically functional derivatives thereof as described herein.

[035] The amount of a compound of formula I necessary to achieve the desired biological effect depends on a number of factors, for example the specific compound chosen, the intended use, the mode of administration and the clinical

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condition of the patient. The daily dose is generally in the range from about 0.3 mg to 100 mg (typically from about 3 mg to 50 mg) per day and per kilogram of body weight, for example about 3-10 mg/kg/day. An intravenous dose may be, for example, in the range from about 0.3 mg to 1.0 mg/kg, which can suitably be administered as an infusion of about 10 ng to 100 ng per kilogram per minute. Suitable infusion solutions for these purposes may contain, for example, from about 0.1 ng to 10 mg, typically from about 1 ng to 10 mg, per milliliter. Single doses may contain, for example, from about 1 mg to 10 g of the active compound. Thus, ampoules for injections may contain, for example, from about 1 mg to 100 mg, and single-dose formulations which can be administered orally, such as, for example, capsules or tablets, may contain, for example, from about 1.0 to 1000 mg, typically from about 10 to 600 mg. For the therapy of the abovementioned conditions, the compounds of formula I may be used as the compound itself, but they may be in the form of a pharmaceutical composition with an acceptable carrier. The carrier is acceptable in the sense that it is compatible with the other ingredients of the composition and is not harmful to the patient's health. The carrier may be a solid or a liquid or both and is often formulated with the compound as a single dose, for example as a tablet, which may contain from about 0.05% to 95% by weight of the active compound. Other pharmaceutically active substances may likewise be present, including other compounds of formula I. The pharmaceutical compositions of the invention can be produced by one of the known pharmaceutical methods, which may essentially consist of mixing the ingredients with pharmacologically acceptable carriers and/or excipients.

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[036] Pharmaceutical compositions of the invention include those suitable for oral, rectal, topical, peroral (for example sublingual) and parenteral (for example subcutaneous, intramuscular, intradermal or intravenous) administration, although the most suitable mode of administration depends in each individual case on the nature and severity of the condition to be treated and on the nature of the compound of formula I used in each case. Coated formulations and coated slow-release formulations also belong within the framework of the invention. Preference is given to acid- and gastric juice-resistant formulations. Suitable coatings resistant to gastric juice comprise cellulose acetate phthalate, polyvinyl acetate phthalate, hydroxypropylmethylcellulose phthalate and anionic polymers of methacrylic acid and methyl methacrylate.

[037] Suitable pharmaceutical compounds for oral administration may be in the form of separate units such as, for example, capsules, wafers, suckable tablets or tablets, each of which contain a defined amount of the compound of formula I; as powders or granules, as solution or suspension in an aqueous or nonaqueous liquid; or as an oil-in-water or water-in-oil emulsion. These compositions may, as already mentioned, be prepared by any suitable pharmaceutical method which includes a step in which the active compound and the carrier (which may consist of one or more additional ingredients) are brought into contact. The compositions are generally produced by uniform and homogeneous mixing of the active compound with a liquid and/or finely divided solid carrier, after which the product is shaped if necessary. Thus, for example, a tablet can be produced by compressing or molding a powder or granules of the compound, where appropriate with one or more

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additional ingredients. Compressed tablets can be produced by tableting the compound in free-flowing form such as, for example, a powder or granules, where appropriate mixed with a binder, glidant, inert diluent and/or one or more surface-active/dispersing agent(s) in a suitable machine. Molded tablets can be produced by molding the compound which is in powder form and is moistened with an inert liquid diluent in a suitable machine.

[038] Pharmaceutical compositions which are suitable for peroral (sublingual) administration comprise suckable tablets which contain a compound of formula I with a flavoring, normally sucrose and gum arabic or tragacanth, and pastilles which comprise the compound in an inert base such as gelatin and glycerol or sucrose and gum arabic.

[039] The pharmaceutical compositions suitable for parenteral administration may comprise sterile aqueous preparations of a compound of formula I, which may be isotonic with the blood of the intended recipient. These preparations may be administered intravenously, although administration may also take place by subcutaneous, intramuscular or intradermal injection. These preparations can be produced by mixing the compound with water and making the resulting solution sterile and isotonic with blood. Injectable compositions of the invention generally contain from about 0.1 to 5% by weight of the active compound.

[040] Pharmaceutical compositions suitable for rectal administration may be in the form of single-dose suppositories. These can be produced by mixing a compound of formula I with one or more conventional solid carriers, for example cocoa butter, and shaping the resulting mixture.

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[041] Pharmaceutical compositions suitable for topical use on the skin may be in the form of an ointment, cream, lotion, paste, spray, aerosol or oil. Carriers which can be used are petrolatum, lanolin, polyethylene glycols, alcohols and combinations of two or more of these substances. The active compound is generally present in a concentration of from about 0.1 to 15% by weight of the composition, for example from about 0.5 to 2%.

[042] Transdermal administration is also possible. Pharmaceutical compositions suitable for transdermal uses can be in the form of single plasters which are suitable for long-term close contact with the patient's epidermis. Such plasters suitably contain the active compound in an aqueous solution which is buffered where appropriate, dissolved and/or dispersed in an adhesive or dispersed in a polymer. A suitable active compound concentration is about 1% to 35% by weight, or about 3% to 15%. A possibility is for the active compound to be released by electrotransport or iontophoresis as described, for example, in Pharmaceutical Research, 2(6): 318 (1986).

[043] The invention furthermore provides a process for preparing the compounds of formula I which comprises obtaining the compounds of formula I by proceeding in accordance with the reaction scheme below:

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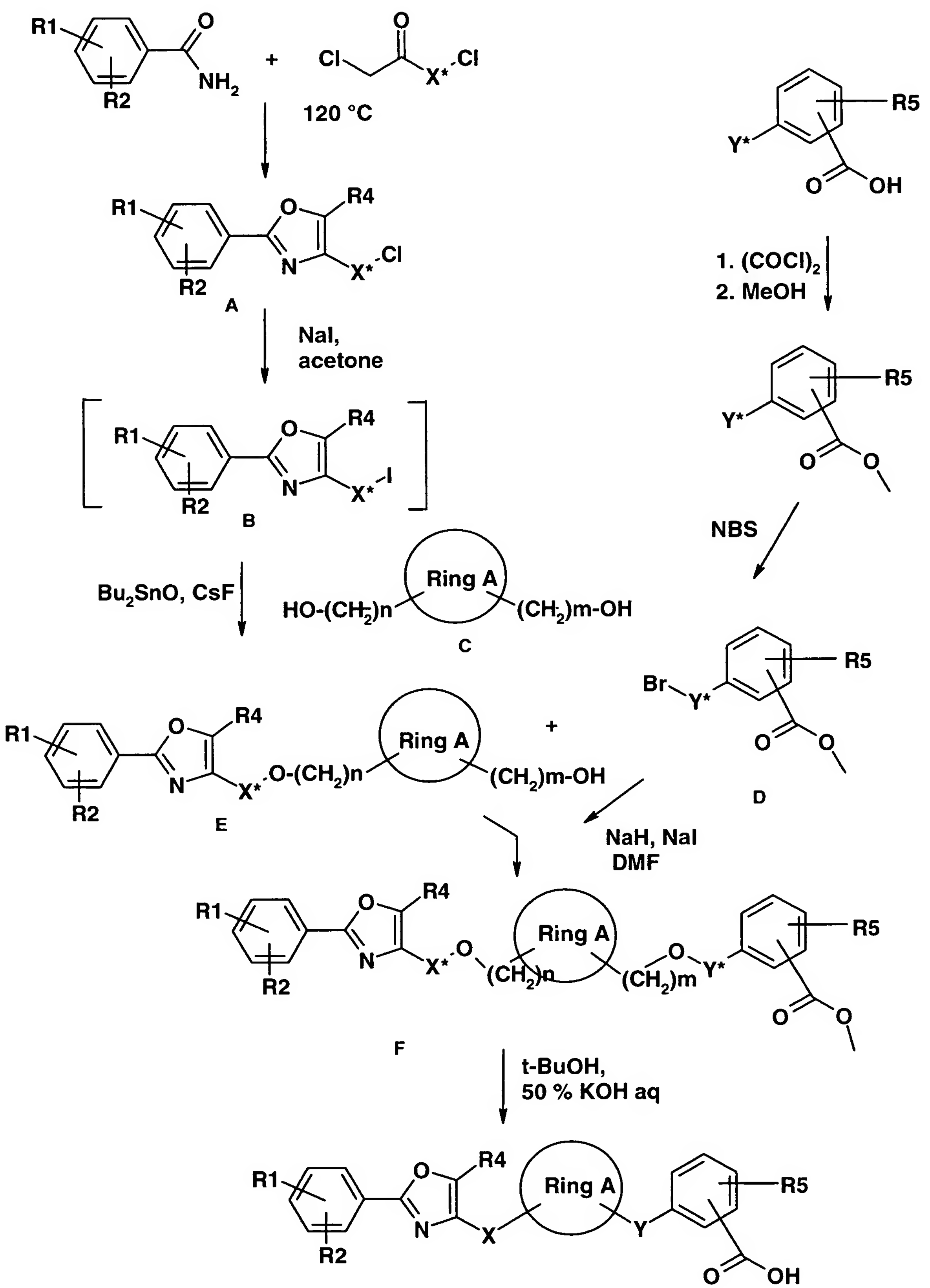

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[044] To this end, compounds of formula A in which R1, R2, R4 and X have the meanings given above are reacted with NaI in acetone with heating at reflux for about 12 to 24 hours, giving a compound of formula B.

[045] The compound of formula B is reacted with a compound of formula C in which n and m are each 0-5, giving a compound of formula E in which R1, R2, R4, m, n and X have the meanings described above. Here, (a) C is deprotonated at room temperature in an inert solvent such as dimethylformamide or tetrahydrofuran using sodium hydride and then reacted at about 70°C with the halide, or (b) component C is initially heated with dibutyltin oxide in toluene on a water separator for a number of hours and then, with addition of dimethylformamide, cesium fluoride and iodide B, converted into E by stirring at room temperature for a number of hours, such as between about 10 and 14 hours, preferably overnight.

[046] The compound of formula E is, using a compound of formula D in which Y is as described above, converted into a compound of formula F in which R1, R2, R4, R5, X and Y have the meanings described above. To form an ether bond, E is deprotonated, for example in a mixture of dimethylformamide and tetrahydrofuran using a strong base such as Na hydride at room temperature, and then alkylated with a component D, often with addition of Na iodide.

[047] The compound of formula F is converted into compounds of formula I by hydrolyzing the ester function, for example by heating with potassium hydroxide in an alcohol (ethanol, tert-butanol) and releasing the carboxylic acid group of formula I by acidification. This carboxylic acid group can be derivatized by

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customary methods to a group of the formula -(C=O)-OR3, where R3 has the meaning described above.

[048] The compounds of formula I act favorably on metabolic disorders. They have a positive effect on lipid and sugar metabolism and, in particular, reduce the concentration of triglycerides, and they are suitable for preventing and treating type II diabetes and arteriosclerosis.

[049] The compounds can be administered alone or in combination with one or more further pharmacologically active substances which, for example, act favorably on metabolic disorders and are selected, for example, from antidiabetics, antiadipose agents, antihypertensives and active compounds for treating and/or preventing complications caused by or associated with diabetes.

[050] Suitable further pharmacologically active substances are:

[051] All antidiabetics mentioned in chapter 12 of Rote Liste 2001. They may be combined with the compounds of formula I according to the invention for synergistic improvement of the effect. Administration of the active compound combination may take place either by separate administration of the active compounds to the patients or in the form of combination products in which a plurality of active compounds are present in one pharmaceutical preparation. Most of the active compounds listed below are disclosed in USP Dictionary of USAN and International Drug Names, US Pharmacopeia, Rockville, MD 2001.

[052] Antidiabetics include insulin and insulin derivatives such as, for example, Lantus® (see www.lantus.com) or HMR 1964, fast-acting insulins (see US 6,221,633), GLP-1 derivatives such as, for example, those disclosed in

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WO 98/08871 of Novo Nordisk A/S, and orally active hypoglycemic active compounds.

[053] Orally active hypoglycemic active compounds include sulfonylureas, biguanides, meglitinides, oxadiazolidinediones, thiazolidinediones, glucosidase inhibitors, glucagon antagonists, GLP-1 agonists, potassium channel openers such as, for example, those disclosed in WO 97/26265 and WO 99/03861 of Novo Nordisk A/S, insulin sensitizers, inhibitors of liver enzymes involved in the stimulation of gluconeogenesis and/or glycogenolysis, modulators of glucose uptake, compounds which alter lipid metabolism, such as antihyperlipidemic active compounds and antilipidemic active compounds, compounds which reduce food intake, PPAR and PXR agonists and active compounds which act on the ATP-dependent potassium channel of beta cells.

[054] In one embodiment of the invention, the compounds of formula I are administered in combination with an HMG-CoA reductase inhibitor such as simvastatin, fluvastatin, pravastatin, lovastatin, atorvastatin, cerivastatin or rosuvastatin.

[055] In one embodiment of the invention, the compounds of formula I are administered in combination with a cholesterol absorption inhibitor such as, for example, ezetimibe, tiqueside or pamaqueside.

[056] In one embodiment of the invention, the compounds of formula I are administered in combination with a PPAR gamma agonist such as, for example, rosiglitazone, pioglitazone, JTT-501 or GI 262570.

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[057] In one embodiment of the invention, the compounds of formula I are administered in combination with a PPAR alpha agonist such as, for example, GW 9578 or GW 7647.

[058] In one embodiment of the invention, the compounds of formula I are administered in combination with a mixed PPAR alpha/gamma agonist such as, for example, GW 1536, AVE 8042, AVE 8134, or AVE 0847, or as described in PCT/US00/11833, PCT/US00/11490, or DE 10142734.4.

[059] In one embodiment of the invention, the compounds of formula I are administered in combination with a fibrate such as, for example, fenofibrate, clofibrate or bezafibrate.

[060] In one embodiment of the invention, the compounds of formula I are administered in combination with an MTP inhibitor such as, for example, implitapide, BMS-201038 or R-103757.

[061] In one embodiment of the invention, the compounds of formula I are administered in combination with a bile acid adsorption inhibitor (see, for example, US 6,245,744 or US 6,221,897) such as, for example, HMR 1741.

[062] In one embodiment of the invention, the compounds of formula I are administered in combination with a CETP inhibitor such as, for example, JTT-705.

[063] In one embodiment of the invention, the compounds of formula I are administered in combination with a polymeric bile acid adsorbent such as, for example, cholestyramine or colesevelam.

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[064] In one embodiment of the invention, the compounds of formula I are administered in combination with an LDL receptor inducer (see US 6,342,512) such as, for example, HMR1171 or HMR1586.

[065] In one embodiment of the invention, the compounds of formula I are administered in combination with an ACAT inhibitor such as, for example, avasimibe.

[066] In one embodiment of the invention, the compounds of formula I are administered in combination with an antioxidant such as, for example, OPC-14117.

[067] In one embodiment of the invention, the compounds of formula I are administered in combination with a lipoprotein lipase inhibitor such as, for example, NO-1886.

[068] In one embodiment of the invention, the compounds of formula I are administered in combination with an ATP citrate lyase inhibitor such as, for example, SB-204990.

[069] In one embodiment of the invention, the compounds of formula I are administered in combination with a squalene synthetase inhibitor such as, for example, BMS-188494.

[070] In one embodiment of the invention, the compounds of formula I are administered in combination with a lipoprotein(a) lowering agent / HDL enhancer such as, for example, CI-1027 or nicotinic acid.

[071] In one embodiment of the invention, the compounds of formula I are administered in combination with a lipase inhibitor such as, for example, orlistat.

[072] In one embodiment of the invention, the compounds of formula I are administered in combination with insulin.

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[073] In one embodiment, the compounds of formula I are administered in combination with a sulfonylurea such as, for example, tolbutamide, glibenclamide, glipizide or glimepiride.

[074] In one embodiment, the compounds of formula I are administered in combination with a biguanide such as, for example, metformin.

[075] In another embodiment, the compounds of formula I are administered in combination with a meglitinide such as, for example, repaglinide.

[076] In one embodiment, the compounds of formula I are administered in combination with a thiazolidinedione such as, for example, troglitazone, ciglitazone, pioglitazone, rosiglitazone or the compounds disclosed in WO 97/41097 of Dr. Reddy's Research Foundation, such as 5-[[4-[(3,4-dihydro-3-methyl-4-oxo-2-quinazolinylmethoxy]phenyl]methyl]-2,4-thiazolidinedione.

[077] In one embodiment, the compounds of formula I are administered in combination with an α-glucosidase inhibitor such as, for example, miglitol or acarbose.

[078] In one embodiment, the compounds of formula I are administered in combination with an active compound which acts on the ATP-dependent potassium channel of beta cells, such as, for example, tolbutamide, glibenclamide, glipizide, glimepiride or repaglinide.

[079] In one embodiment, the compounds of formula I are administered in combination with more than one of the aforementioned compounds, for example in combination with a sulfonylurea and metformin, a sulfonylurea and acarbose,

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repaglinide and metformin, insulin and a sulfonylurea, insulin and metformin, insulin and troglitazone, insulin and lovastatin, *etc.*

[080] In a further embodiment, the compounds of formula I are administered in combination with CART modulators (see "Cocaine-amphetamine-regulated transcript influences energy metabolism, anxiety and gastric emptying in mice" Asakawa, A, *et al.*, Hormone and Metabolic Research (2001), 33(9), 554-558), NPY antagonists (for example N-{4-[(4-aminoquinazolin-2-ylamino)methyl]cyclohexylmethyl}-naphthalene-1-sulfonamide hydrochloride (CGP 71683A)), MC4 agonists (for example N-[2-(3a-benzyl-2-methyl-3-oxo-2,3,3a,4,6,7-hexahydropyrazolo[4,3-c]pyridin-5-yl)-1-(4-chlorophenyl)-2-oxoethyl]-1-amino-1,2,3,4-tetrahydronaphthalene-2-carboxamide (WO 01/91752)), orexin antagonists (for example 1-(2-methylbenzoxazol-6-yl)-3-[1,5]naphthyridin-4-ylurea hydrochloride (SB-334867-A)), H3 agonists (for example 3-cyclohexyl-1-(4,4-dimethyl-1,4,6,7-tetrahydroimidazo[4,5-c]pyridin-5-yl)propan-1-one oxalic acid salt (WO 00/63208)); TNF agonists, CRF antagonists (for example [2-methyl-9-(2,4,6-trimethylphenyl)-9H-1,3,9-triazafluoren-4-yl]dipropylamine (WO 00/66585)), CRF BP antagonists (for example urocortin), urocortin agonists, β3 agonists (for example 1-(4-chloro-3-methanesulfonylmethylphenyl)-2-[2-(2,3-dimethyl-1H-indol-6-yloxy)ethylamino]ethanol hydrochloride (WO 01/83451)), MSH (melanocyte-stimulating hormone) agonists, CCK-A agonists (for example {2-[4-(4-chloro-2,5-dimethoxyphenyl)-5-(2-cyclohexylethyl)-thiazol-2-ylcarbamoyl]-5,7-dimethylindol-1-yl}acetic acid trifluoroacetic acid salt (WO 99/15525)); serotonin reuptake inhibitors (for example dexfenfluramine), mixed serotoninergic and noradrenergic compounds

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(for example WO 00/71549), 5HT agonists (for example 1-(3-ethylbenzofuran-7-yl)piperazine oxalic acid salt (WO 01/09111)), bombesin agonists, galanin antagonists, growth hormone (for example human growth hormone), growth-hormone-releasing compounds (tert-butyl 6-benzyloxy-1-(2-diisopropylaminoethylcarbamoyl)-3,4-dihydro-1H-isoquinoline-2-carboxylate (WO 01/85695)), TRH agonists (see, for example, EP 0 462 884), decoupling protein 2 or 3 modulators, leptin agonists (see, for example, Lee, Daniel W.; Leinung, Matthew C.; Rozhavskaya-Arena, Marina; Grasso, Patricia, "Leptin agonists as a potential approach to the treatment of obesity," Drugs of the Future (2001), 26(9), 873-881), DA agonists (for example bromocriptin or doprexin), lipase/amylase inhibitors (for example WO 00/40569), PPAR modulators (for example WO 00/78312), RXR modulators or TR β agonists.

[081] In one embodiment of the invention, the other active compound is leptin; see, for example, "Perspectives in the therapeutic use of leptin", Salvador, Javier; Gomez-Ambrosi, Javier; Fruhbeck, Gema, Expert Opinion on Pharmacotherapy (2001), 2(10), 1615-1622.

[082] In one embodiment, the other active compound is dexamphetamine or amphetamine.

[083] In one embodiment, the other active compound is fenfluramine or dexfenfluramine.

[084] In a further embodiment, the other active compound is sibutramine.

[085] In one embodiment, the other active compound is orlistat.

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[086] In one embodiment, the other active compound is mazindol or phentermine.

[087] In one embodiment, the compounds of formula I are administered in combination with dietary fiber materials, such as insoluble dietary fiber materials (see, for example, carob/Caromax® (Zunft H J; *et al.*, Carob pulp preparation for treatment of hypercholesterolemia, ADVANCES IN THERAPY (2001 Sep-Oct), 18(5), 230-6). Caromax® is a carob-containing product from Nutrinova, Nutrition Specialties & Food Ingredients GmbH, Industriepark Höchst, 65926 Frankfurt/Main, Germany. Combination with Caromax® is possible in one preparation or by separate administration of compounds of formula I and Caromax®. Caromax® can moreover be administered in the form of foodstuffs such as, for example, in bakery products or muesli bars.

[088] It is self-evident that any suitable combination of the compounds of the invention with one or more of the aforementioned compounds and optionally one or more other pharmacologically active substances is regarded as falling within the protection conferred by the present invention.

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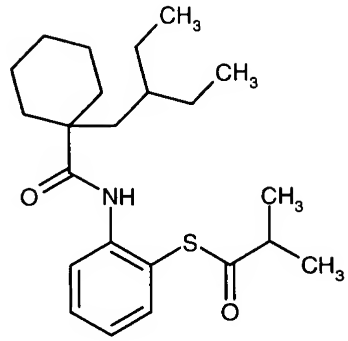

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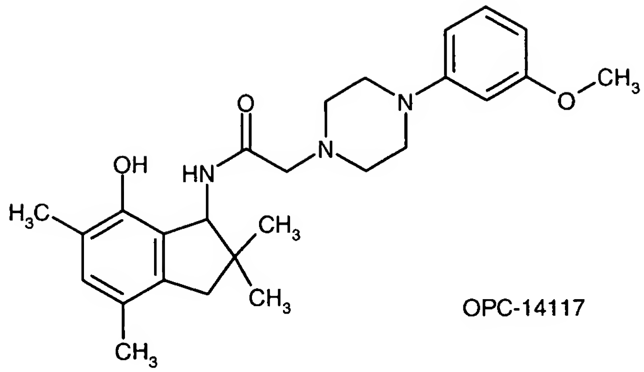

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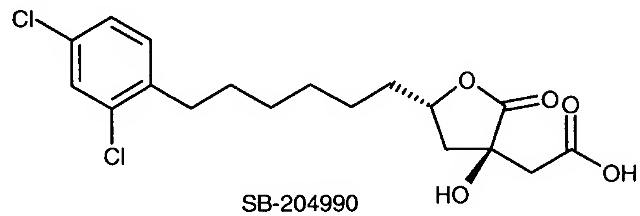

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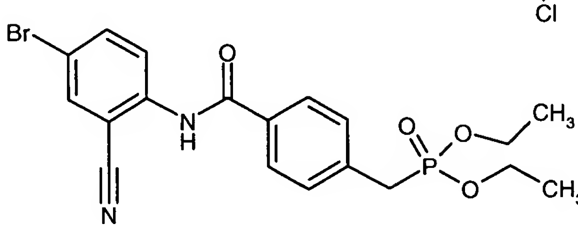

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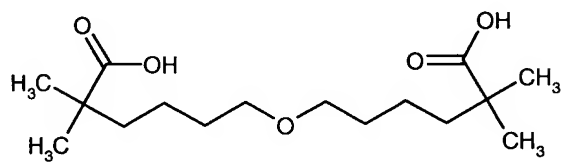

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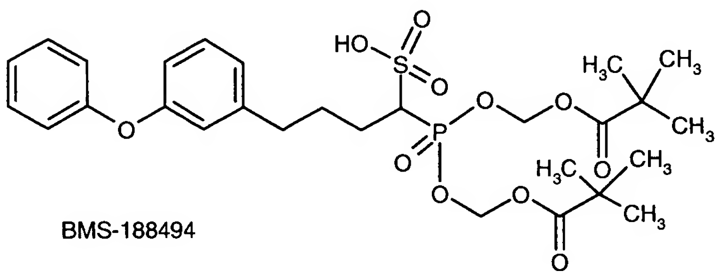

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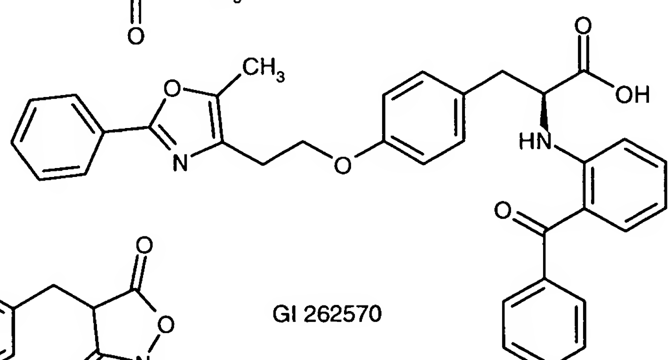

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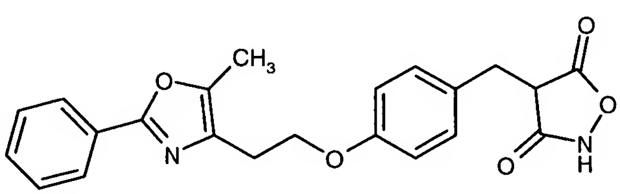

JTT-501

[089] This invention furthermore relates to the use of compounds of formula I and their pharmaceutical compositions as PPAR ligand receptor binders. The PPAR ligand receptor binders according to the invention are suitable for use as agonists or antagonists of the PPAR receptor.

[090] Peroxisome-proliferator-activated receptors (PPAR) can be divided into the three subtypes PPARα, PPARδ and PPARγ. These are encoded by different genes (Motojima, Cell Structure and Function, 18:267-277, 1993). In addition, there are two isotopes of PPARγ, PPARγ_1 and γ_2. These two proteins differ in the 30 NH_2-terminal amino acids and are the result of an alternative use of promoters and different mRNA splicing (Vidal-Puig, Jiminez, Linan, Lowell, Hamann, Hu, Spiegelman, Flier, Moller, J. Clin. Invest., 97:2553-2561, 1996).

[091] PPAR-modulated biological processes are processes modulated by receptors or combinations of receptors which react to the PPAR receptor ligands described in the present document. These processes include, for example, plasma lipid transport and fatty acid catabolism, regulation of insulin sensitivity and blood glucose levels involved in hypoglycemia/hyperinsulinism (caused, for example, by functional disorders of the pancrease beta-cells, insulin-secreting tumors and/or autoimmune hypoglycemia owing to autoantibodies against insulin, the insulin receptor or autoantibodies having a stimulating action on pancrease beta-cells), macrophage differentiation resulting in the formation of atherosclerotic plaques, in inflammable reactions, carcinogenesis, hyperplasia or adipocyte differentiation.

[092] Adiposity is an excessive buildup of fatty tissue. Recent investigations in this field have shown that PPARγ plays a central role in gene expression and

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differentiation of adipocytes. Excess fatty tissue is associated with the development of serious disorders such as, for example, non-insulin-dependent diabetes mellitus (NIDDM), hypertension, disorders of the coronary arteries, hyperlipidemia, adiposity and certain malignant syndromes. The adipocytes can, by forming tumor necrosis factor α (TNFα) and other molecules, also have an effect on glucose homeostasis.

[093] Non-insulin-dependent diabetes mellitus (NIDDM) or type II diabetes is the more frequent form of diabetes. About 90-95% of hyperglycemia patients suffer from this form of the disease. What is present in NIDDM is apparently a reduction of the mass of the beta cells of the pancreas, a number of different disorders of insulin secretion or reduced insulin sensitivity of the tissue. The symptoms of this form of diabetes include tiredness, frequent urination, thirst, blurred vision, frequent infections and slow healing of wounds, diabetic nerve damage and kidney diseases.

[094] Resistance against the metabolic effects of insulin is one of the main features of non-insulin-dependent diabetes (NIDDM). Insulin resistance is characterized by reduced uptake and conversion of glucose in insulin-sensitive target organs such as, for example, adipocytes and skeletal muscles, and by reduced inhibition of hepatic gluconeogenesis. Functional insulin deficiency and the absent suppression of hepatic gluconeogenesis by insulin leads to hyperglycemia in the fasting state. The pancreas beta-cells compensate for insulin resistance by increased secretion of insulin. However, the beta-cells are not able to maintain this high insulin output, so that the glucose-induced insulin secretion decreases, resulting in a deterioration of glucose homeostasis and finally in the development of manifest diabetes.

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[095] Hyperinsulinemia is likewise associated with insulin resistance, hypertriglyceridemia and increased plasma concentrations of low-density lipoproteins. Insulin resistance and hyperinsulinemia combined with these metabolic disorders is called "syndrome X" and is strongly associated with an increased risk of hypertension and disorders of the coronary arteries.

[096] Metformin is known to the person skilled in the art as an agent for treating diabetes in humans (US Patent No. 3,174,901). The primary action of metformin is reduced formation of glucose in the liver. As is known, Troglitazone® acts primarily by improving the ability of skeletal muscles to react to insulin and to take up glucose. It is known that a combination therapy of metformin and Troglitazone® can be used for treating diabetes-associated disorders (DDT 3:79-88, 1998).

[097] It has been observed that PPARγ activators, such as Troglitazone®, convert cancerous tissue in liposarcoma (fat tumors) into normal cells (PNAS 96:3951-3956, 1999). Furthermore, it has been proposed that PPARγ activators may be of benefit in the treatment of breast cancer and intestinal cancer (PNAS 95:8806-8811, 1998; Nature Medicine 4:1046-1052, 1998).

[098] In addition, PPARγ activators such as, for example, Troglitazone® have also been used for treating polycystic ovarial syndrome (PCO). This syndrome, which occurs in women, is characterized by chronic anovulation and hyperandrogenism. Women with this syndrome frequently also suffer from insulin resistance and an increased risk of developing non-insulin-dependent diabetes

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mellitus (Dunaif, Scott, Finegood, Quintana, Whitcomb, J. Clin. Endocrinol. Metab., 81:3299, 1996).

[099] Furthermore, it has recently been discovered that PPARγ activators increase the formation of progesterone and inhibit steroid genesis in granulosa cell cultures and may therefore be suitable for treating climacterium (US Patent No. 5,814,647, Urban *et al.*, 29 September 1998; B. Lorke *et al.*, Journal of Endocrinology, 159, 429-39, 1998). Climacterium is defined as the syndrome of the endocrine, somatic and psychological changes which occur in women at the end of the reproductive phase.

[0100] Peroxisomes are cellular organelles involved in the control of the redox potential and oxidative stress in cells by metabolizing a large number of substrates such as, for example, hydrogen peroxide. A number of disorders are associated with oxidative stress. Thus, for example, inflammable reactions to tissue damage, pathogenesis of emphysema, ischemia-associated organ damage (shock), doxorubicin-induced heart damage, drug-induced hepatotoxicity, atherosclerosis and lung damage caused by hyperoxia are in each case associated with the formation of reactive oxygen species and changes of the reductive capability of the cell. Accordingly, it has been proposed that PPARα activators regulate *inter alia* the redox potential and the oxidative stress in cells and may be useful for treating these disorders (Poynter *et al.*, J. Biol. Chem. 273, 32833-41, 1998).

[0101] It has also been found that PPARα agonists inhibit $NF_{K}B$-mediated transcription and thus modulate various inflammatory reactions, such as, for example, the enzyme paths of inducible nitrous oxide synthase (NOS) and

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cyclooxygenase-2 (COX-2) (Pineda-Torra, I. *et al.*, 1999, Curr. Opinion in Lipidology, 10, 151-9) and can therefore be used for therapeutic interventions in a large number of different inflammatory diseases and other pathological conditions (Colville-Nash *et al.*, Journal of Immunology, 161, 978-84, 1998; Staels et al, Nature, 393, 790-3, 1998).

[0102] Peroxisome proliferators activate PPAR which, in turn, act as transcription factors and cause differentiation, cell growth and proliferation of peroxisomes. It is also presumed that PPAR activators play a role in hyperplasia and carcinogenesis and change the enzymatic properties of animal cells such as, for example, rodent cells; however, these PPAR activators appear to have only minimal negative effects on human cells (Green, Biochem. Pharm. 43(3):393, 1992). Activation of PPAR leads to a rapid increase of gamma-glutamyl transpeptidase and -catalase.

[0103] PPARα is activated by a number of medium-chain fatty acids and long-chain fatty acids and is involved in the stimulation of β-oxidation of fatty acids in tissues such as liver, heart, skeletal muscle and brown fatty tissue (Issemann and Green, ibid.; Beck *et al.*, Proc. R. Soc. Lond. 247:83-87, 1992; Gottlicher *et al.*, Proc. Natl. Acad. Sci. USA 89:4653-4657, 1992).

[0104] Pharmacological PPARα activators such as, for example, fenofibrate, clofibrate, gemfibrozil and bezafibrate are likewise involved in the considerable reduction of plasma triglycerides and a moderate reduction of LDL cholesterol, and they are used for treating hypertriglyceridemia, hyperlipidemia and adiposity. It is

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known that PPARα is also involved in inflammatory disorders (Schoonjans, K., Current Opinion in Lipidology, 8, 159-66, 1997).

[0105] The human nuclear receptor PPARδ has been cloned from a cDNA library of human osteosarcoma cells and is described completely in A. Schmidt *et al.*, Molecular Endocrinology, 6:1634-1641 (1992). The contents of this article are hereby incorporated by reference into the present document. It may be pointed out that in the literature PPARδ is also referred to as PPARβ and as NUC1, but all of these names refer to the same receptor. Thus, in A. Schmidt *et al.*, Molecular Endocrinology, 6:1634-1641, 1992, for example, the receptor is referred to as NUC1. PPARδ is found both in embryonal and in adult tissue. It has been reported that this receptor is involved in the regulation of the expression of some fat-specific genes and therefore plays a role in the process of adipogenesis (Amri, E. *et al.*, J. Biol. Chem. 270, 2367-71, 1995).

[0106] It is known that atherosclerotic disorders are caused by a number of factors such as, for example, hypertension, diabetes, low concentrations of high-density lipoproteins (HDL) and high concentrations of low-density lipoproteins (LDL). In addition to reducing the risks by acting on the concentration of the plasma lipids and other risk factors, PPARα agonists have direct atheroprotective actions (Frick, M.H. *et al.*, 1997, Circulation 96:2137-2143, de Faire *et al.*, 1997, Cardiovasc. Drugs Ther. 11 Suppl. 1:257-63).

[0107] It has recently been found that PPARδ agonists are useful for increasing HDL level and are therefore suitable for treating atherosclerotic disorders (Leibowitz *et al.*, WO 97/28149). Atherosclerotic disorders include vascular

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disorders, coronary heart disease, cerebrovascular disorders and disorders of the peripheral vessels. Coronary heart disease includes death by coronary heart disease, myocardial infarction and coronary revascularization. Cerebrovascular diseases include ischemic and hemorrhagic infarcts and transient ischemic attacks.

[0108] PPARγ subtypes are involved in the activation of adipocyte differentiation and do not play any role in the stimulation of peroxysome proliferation in the liver. Activation of PPARγ contributes to adipocyte differentiation by activating the adipocyte-specific gene expression (Lehmann, Moore, Smith-Oliver, Wilkison, Willson, Kliewer, J. Biol. Chem., 270:12953-12956, 1995). The DNA sequences of the PPARγ subtypes are described in Elbrecht *et al.*, BBRC 224; 431-437 (1996). Although peroxysome proliferators including fibrates and fatty acids activate the transciptory activity of PPARs, only prostaglandin J_2 derivatives such as the arachidonic metabolite 15-deoxy-delta^{12}, 14-prostaglandin J_2 (15d-PGJ_2) have been identified as natural ligands specific for the PPARγ subtype which also binds to thiazolidinediones. This prostaglandin activates PPARγ-dependent adipogenesis, but activates PPARα only at high concentrations (Formann, Tontonoz, Chen, Brun, Spiegelman, Evans, Cell, 83:803-812, 1995; Kliewer, Lenhard, Wilson, Patel, Morris, Lehmann, Cell, 83:813-819, 1995). This is a further indication that the subtypes of the PPAR family differ in their pharmacological reaction to ligands.

[0109] From this, it can be concluded that compounds which activate PPARα or both PPARα and PPARγ have to be effective hypotriglyceridemic drugs which can be used for treating atherosclerosis-associated dislipidemia, non-insulin-dependent diabetes mellitus, syndrome X (Staels, B. *et al.*, Curr. Pharm. Des., 3 (1), 1-4 (1997))

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and familial combined hyperlipidemia (FCH). Syndrome X is characterized by a first insulin-resistant stage which causes hyperinsulinemia, dyslipidemia and reduced glucose tolerance and which can progress to non-insulin-dependent diabetes mellitus (type II diabetes) characterized by hyperglycemia. FCH is characterized by hypercholesterolemia and hypertriglyceridemia in the same patient and in the same family.

[0110] The present invention relates to compounds of formula I suitable for modulating PPAR receptors, and for a number of other related pharmaceutical applications.

[0111] The compounds of formula I are suitable for treating dyslipidemia, insulin resistance, type I and type II diabetes, disturbed glucose tolerance, syndrome X, obesity, eating disorders, thromboses, inflammations, cardiomyopathy and for protecting beta-cells and protection against fatty acid oxidation (see, for example, Jean-Charles Fruchart, Bart Staels and Patrick Duriez: PPARS, Metabolic Disease and Atherosclerosis, Pharmacological Research, Vol. 44, No. 5, 2001; Sander Kersten, Beatrice Desvergne & Walter Wahli: Roles of PPARs in health and disease, NATURE, VOL 405, 25 MAY 2000; Ines Pineda Torra, Giulia Chinetti, Caroline Duval, Jean-Charles Fruchart and Bart Staels: Peroxisome proliferator-activated receptors: from transcriptional control to clinical practice, Curr Opin Lipidol 12: 2001, 245-254).

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[0112] The activity of the compounds was tested as follows:

[0113] To analyze the effectiveness of substances which bind to human PPARα, activating it in agonistic manner, a stable transfected HEK cell line (HEK = human embryo kidney) designated here as "PPARα reporter cell line" is used. It contains two genetic elements, a firefly luciferase reporter element and a PPARα fusion protein (GR-GAL4-PPARα) which controls the expression of the firefly luciferase reporter element in a PPARα ligand dependent way.

The PPARα reporter cell line was established in two steps: First, the firefly luciferase reporter element was constructed and stably transfected into HEK cells. Five DNA binding sites for the yeast transcription factor GAL4 (five repetitions of the sequence 5´-CGGAGTACTGTCCTCCGAG-3´) were cloned 5´ upstream of a 68 bp minimal RNA polymerase II promoter from the GR mouse mammary tumor virus long terminal repeat (accession # V01175) providing a CCAAT-box as well as a TATA-element. Cloning and sequencing was done as described by Sambrook J. et. al. (Molecular cloning, Cold Spring Harbor Laboratory Press, 1989). The complete Photinus pyralis luciferase gene (accession # M15077) was cloned 3´ downstream of the GAL4 binding sites and the MMTV minimal promoter. The firefly luciferase reporter element consisting of 5 GAL4 binding sites, the MMTV minimal promoter and the full length luciferase gene was recloned into a plasmid backbone harboring a Zeozin resistence gene leading to plasmid "pdeltaMG4LZ". This vector was transfected in HEK cells as described by Ausubel, F.M. et al. (Current protocols in molecular biology, Vol. 1-3, John Wiley & Sons, Inc., 1995). Stable clones have been selected using Zeozin as a selection agent (0.5 mg/ml).

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In a second step, the PPARα fusion protein (GR-GAL4-PPARα) that controls expression of the firefly luciferase reporter element, was stably integrated in this cell background. For this purpose the cDNAs coding for the N-terminal 76 amino acids of the human glucocorticoid receptor ("GR", accession # P04150) have been linked to amino acids 1-147 of the yeast GAL4-protein (accession # P04386) followed by the ligand binding domain of human PPARα (amino acids S167-Y468, accession # S74349). The GR-GAL4-humanPPARα construct was cloned into plasmid pcDNA3 (Invitrogen) were its expression is driven constitutively by the Cytomegalovirus promoter. The plasmid pcDNA3-GR-GAL4-humanPPARα was transfected in a stable HEK-cell clone that already contained the firefly luciferase reporter element described above. A double-transfected cell line containing both, the firefly luciferase reporter element as well as the GR-GAL4-humanPPARα fusion protein, has been selected on medium supplemented with Zeozin (0.5 mg/ml) and G418 (0.5 mg/ml).

[0114] The activity of PPARα agonists is determined in a three day test, described below:

Day 1

[0115] The PPARα reporter cell line is cultivated up to 80% confluence in DMEM medium (# 41965-039, Life Technologies) with the following additives: 10% cs-FCS (fetal calf serum, #SH-30068.03, Hyclone), antibiotics (0.5 mg/ml of zeozin [#R250-01, Invitrogen], 0.5 mg/ml of G418 [#10131-019, Life Technologies], 1% penicillin streptomycin solution [#15140-031, Life Technologies]) and 2 mM of L-glutamine (#25030-032, Life Technologies). Cultivation is carried out in standard

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cell culture bottles (# 33111, Becton Dickinson) in a cell culture incubator at 37°C and 5% CO_2. The 80% confluent cells are washed once with 30 ml of PBS (#14190-094, Life Technologies), treated with 2 ml of trypsin solution (#25300-054, Life Technologies) at 37°C for 2 min, taken up in 5 ml of the medium described above and counted in a cell counter. After dilution to 500,000 cells/ml, in each case 35.000 cells are sown into each well of a 96-well microtiter plate having a clear plastic bottom (#3610, Corning Costar). The plates are incubated in a cell incubator at 37°C and 5% CO_2 for 24 h.

Day 2

[0116] The PPARα agonists to be tested are dissolved in DMSO at a concentration of 10 mM. This stock solution is diluted in Phenol-Red-free DMEM medium (#21063-029, Life Technologies) to which 5% of cs-FCS (#SH-30068.03, Hyclone), 2 mM of L-glutamine (#25030-032, Life Technologies) and the antibiotics described above (zeozin, G418, penicillin and streptomycin) had been added.

[0117] Test substances are usually tested at 11 different concentrations (10 μM; 3.3 μM; 1 μM; 0.33 μM; 0,1 μM; 0.033 μM; 0.01 μM; 0.0033 μM; 0.001 μM; 0.00033 μM and 0.0001 μM). More potent compounds are tested in concentration ranges of from 1 μM to 10 pM or 100 nM to 1 pM. From each well, the medium of the PPARα reporter cell line sown on day 1 is completely removed by aspiration, and immediately, the test substances diluted in medium are added to the cells. Dilution and addition of the substances can be carried out using a robot (Beckman Biomek 2000). The end volume of the test substances diluted in medium is 100 μl

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per well of a 96-well plate. The DMSO concentration in the assay is always below 0.1% v/v to prevent cytotoxic effects of the solvent.

[0118] To demonstrate that the assay is working in each individual plate, a standard PPARα agonist, which is also diluted to 11 different concentrations, is added to each plate. The test plates are incubated in an incubator at 37°C and 5% CO_2 for 24 h.

Day 3

[0119] The PPARα reporter cells treated with the test substances are removed from the incubator and frozen at -20°C for 1 h to improve cell lysis. After the plates have thawed (thawing at room temperature for at least 30 min), 50 µl of buffer 1 (Luc-Screen kit #LS1000, PE Biosystems Tropix) are pipetted into each well and the plates are then transferred into an apparatus for measuring luminescence, fitted with a pipetting unit (Luminoscan Ascent, LabSystems). The luciferase reaction in the measurement apparatus is started by pipetting 50 µl of buffer 2 (Luc-Screen kit #LS1000, PE Biosystems Tropix) into each well of the 96-well plate. Addition of buffer to the individual wells is carried out in defined and identical time intervals following the instructions of the manufacturer (LabSystems). All samples are measured exactly 16 min after addition of buffer 2. Measurement time is 10 sec per sample.

[0120] The crude data of the apparatus for measuring luminescence are exported into a Microsoft Excel file. Dose-activity curves and EC_{50} values are calculated using the program XL.Fit according to the instructions of the manufacturer (IDBS).

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[0121] The results for the activity of the compounds of formula I according to the invention are listed in Table I below:

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TABLE I

Example No.	EC50 PPARα [nM]
I	1
II	0.3
IV	0.3
VI	0.18
VII	4
VIII	0.04
IX	0.04
X	0.5
XIX	16
XXIV	0.9
XXV	1.3
XXVIII	0.67
XXIX	1.4
XLVIII	0.25
IL	0.52
L	0.19
LI	0.31
LII	0.10
LIII	0.40
LIV	0.08
LV	0.09
LVI	0.54
LVII	0.13
LVIII	0.46
LIX	0.62
LX	0.20
LXI	10
LXII	0.08
LXIII	0.56
LXIV	0.13
LXV	1.1
LXVI	0.48

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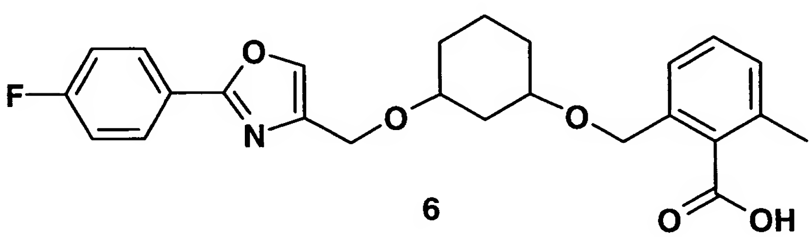
[0122] It is evident from Table I that the compounds of formula I according to the invention activate the PPARα receptor, thus effecting, analogously to clinically used fibrates, a lowering of the triglyceride concentration in the organism (see, for example, J.-Ch. Fruchard *et al.*: PPARS, Metabolic Disease and Atherosclerosis, Pharmacological Research, Vol. 44, No. 5, 2001; S. Kersten *et al.*: Roles of PPARs in health and disease, NATURE, VOL 405, 25 MAY 2000; I. Pineda *et al.*: Peroxisome proliferator-activated receptors: from transcriptional control to clinical practice, Curr Opin Lipidol 12: 2001, 245-254).

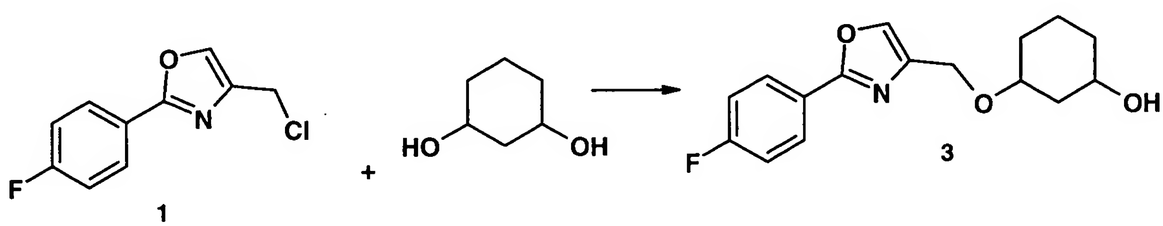
[0123] The examples given below serve to illustrate the invention, but without limiting it. Any measured melting points or decomposition points (m.p.) are uncorrected and, in general, depend on the heating rate.

<u>EXAMPLE I</u>



6

3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexanol **3**



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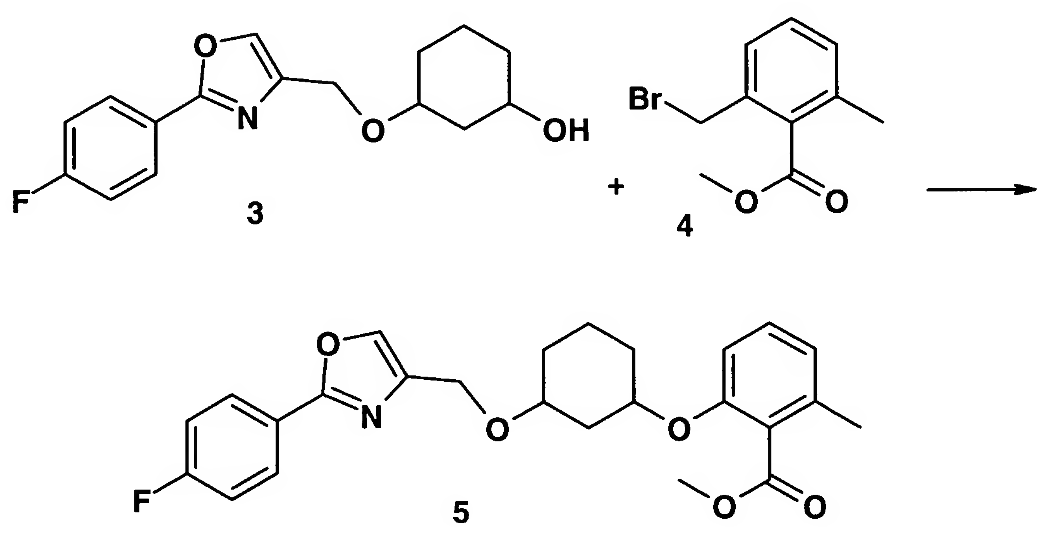
[0124] With ice-cooling, initially 2.25 g of an 80 percent suspension of sodium hydride and then 5.8 g of 1,3-cyclohexanediol were added to a mixture of 50 ml of dimethylformamide and 50 ml of tetrahydrofuran. The mixture was stirred at about 25°C for 3 hours. 10.5 g of 4-chloromethyl-2-(4-fluorophenyl)oxazole (**1**) was then added, the mixture was heated at 70°C and the reaction was monitored by thin-layer chromatography. After the reaction ended, the mixture was poured into ice-water and extracted with ethyl acetate. The organic phase was separated off, dried and concentrated and the residue was purified on silica gel by flash chromatography (ethyl acetate/n-heptane = 1:1). This gave the alcohol **3** as an oil. $C_{16}H_{18}FNO_3$ (291.33) MS(ESI): 292 (M + H^+)

Methyl 2-{3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxy}-6-methylbenzoate **5**



[0125] With ice-cooling, 0.3 g of a sodium hydride suspension (80%) were introduced into a mixture of 10 ml of dimethylformamide and 20 ml of

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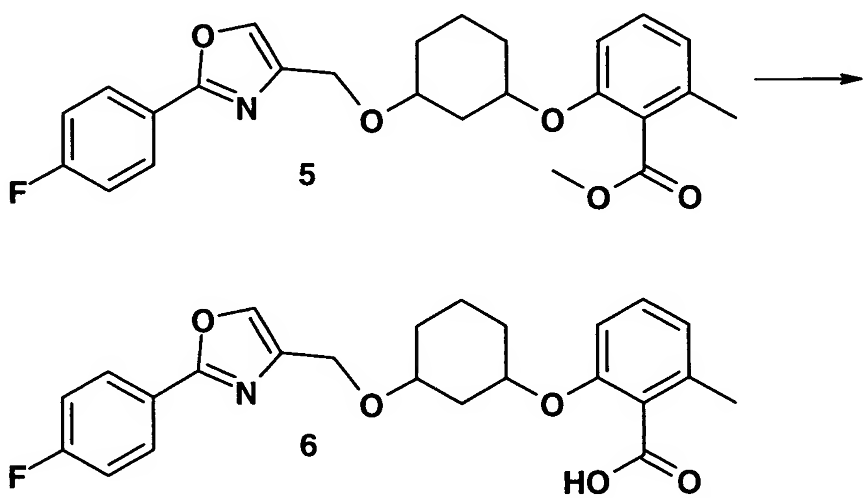
tetrahydrofuran. 1 g of alcohol **3** in 5 ml of tetrahydrofuran was then added, and the mixture was stirred at room temperature for 1 hour. 0.8 g of bromide **4** was then added, and the mixture was stirred at room temperature and with monitoring by TLC for 3-5 hours until the conversion was substantially complete. The mixture was poured into ice-water and extracted 3 times with ethyl acetate, the organic phase was washed with 20 ml portions of water, dried over sodium sulfate and concentrated under reduced pressure at 20 mbar for approximately 1 hour, and the residue was purified by silica gel chromatography (ethyl acetate:n-heptane = 1:2). This gave the methyl ester **5** as an oil.

$C_{26}H_{28}FNO_5$ (453.52) MS(ESI): 454 (M + H^+).

2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxy}-6-methylbenzoic acid **6**



[0126] 2 g of ester **5** were heated at reflux in 150 ml of tert-butanol and 24 ml of 50 percent aqueous potassium hydroxide solution for 6 hours. 4/5 of the butanol was removed under reduced pressure and the mixture was diluted with water and

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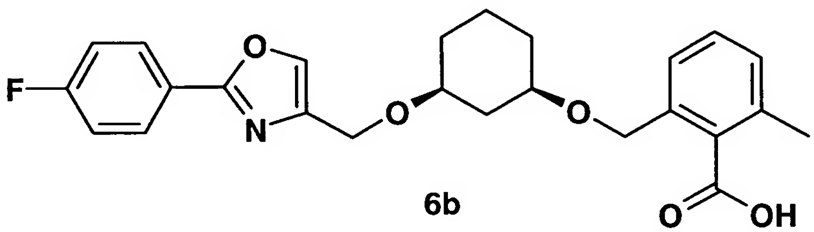
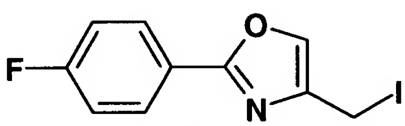
acidified with ice-cooling. The product was extracted with dichloromethane, dried over sodium sulfate and concentrated under reduced pressure, giving, by filtration of the residue through silica gel (CH_2Cl_2/MeOH = 20:1), the acid **6** $C_{25}H_{26}FNO_5$ (432.42) MS(ESI): 433 (M + H^+).

EXAMPLE II



6b

2-(4-Fluorophenyl)-4-iodomethyloxazole **2**



2

[0127] At 120°C, 31 g (123 mmol) of p-fluorobenzamide and 33 g (123 mmol) of 1,3-dichloroacetone were stirred in the absence of a solvent for 2 hours. After cooling to room temperature, the product was dissolved in 250 ml of ethyl acetate. This solution was diluted with 400 ml of n-heptane and washed 3 times with saturated NaCl solution. The organic phase was filtered through 250 ml of silica gel, and the filter pad was then washed with 200 ml of n-heptane/ethyl acetate (4:1). The solvent was distilled off, giving 4-chloromethyl-2-(4-fluorophenyl)oxazole **1** as crude product. This was dissolved in 650 ml of acetone, and 90 g of NaI were then

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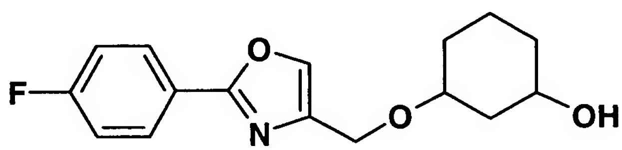
added. The mixture was then heated at reflux for 16 hours, most of the solvent was then removed and the solid residue was suspended in 200 ml of n-heptane/ethyl acetate (1:1) and filtered through 200 ml of silica gel. The precipitate was washed with 500 ml of n-heptane/ethyl acetate (1:1), and the organic phase was concentrated. On concentration, the iodide **2** began to crystallize as white crystals. TLC n-heptane/ethyl acetate (6:1) $R_f = 0.4$ for **2** and $R_f = 0.35$ for **1**. $C_{10}H_7FINO$ (303.08) MS(ESI): 304 ($M + H^+$).



3a (cis) and 3b (trans)

[0128] 10.8 g (93.1 mmol) of cis/trans-1,3-cyclohexanediol and 15.4 g (61.8 mmol) of dibutyltin oxide were heated in 800 ml of toluene on a water separator for 5 hours. 400 ml of toluene were distilled off, and the mixture was then allowed to cool to room temperature, and 280 ml of dry DMF, 15 g (49.5 mmol) of **2** and 12.7 g (80.1 mmol) of dry CsF were then added successively. The heterogeneous mixture was stirred at room temperature for 20 hours (TLC control starting material **2**). 200 ml of ethyl acetate were added, and the mixture was washed three times with saturated NaCl solution. The organic phase was filtered through 150 ml of silica gel and concentrated. Following addition of n-heptane/ethyl acetate (6:1), the residue crystallized. Further recrystallization from n-heptane/ethyl acetate gave the product **3a** (mixture of cis-enantiomers). The mixture of trans-enantiomers **3b** was obtained from the mother liquor after concentration and

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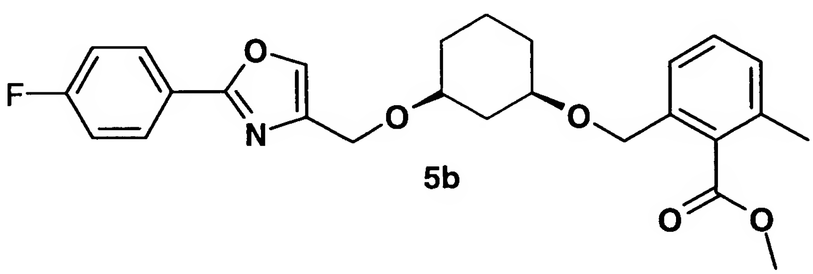
chromatography. TLC n-heptane/ethyl acetate (1:1). R_f **3a** (cis) = 0.2, R_f **3b** (trans) = 0.3. $C_{16}H_{18}FNO_3$ (291.33) MS(ESI): 292 ($M + H^+$).

[0129] The pair of enantiomers **3a** was separated by chiral HPLC. The dextrorotatory (+)-enantiomer **(+)3a** eluted first, followed by the levorotatory (-)-enantiomer **(-)3a** (Chiralpak AD 250 x 4.6; acetonitrile/methanol (9:1)).

[0130] The absolute stereochemistry was assigned by X-ray structural analysis of the camphanic acid esters of the separated diastereomers **3.**

Methyl cis-2-(3-(2-(4-fluorophenyl)oxazol-4-ylmethoxy)cyclohexyloxymethyl)-6-methylbenzoate **5b**



5b

[0131] 1.05 g (3.6 mmol) of **(-)3a**, 1.3 g (5.4 mmol) **4** and 130 mg of KI were dissolved in 12 ml of dry DMF. 140 mg (5.7 mmol) of 95% NaH were added, and the mixture was then stirred at room temperature for 1 hour. To achieve better yields with respect to the starting material **(-)3a**, 2 more times, the same amount of **4** and NaH were added, and the mixture was in each case stirred for 1 hour. The mixture was then allowed to stand overnight. The reaction solution was diluted with 150 ml of ethyl acetate and poured into 50 ml of water. The mixture was washed 2 more

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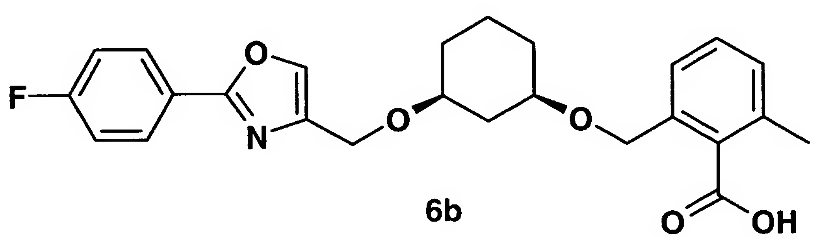
times with NaCl solution, and the organic phase was then filtered through silica gel and concentrated, and the residue was purified by flash chromatography (n-heptane/ethyl acetate, 1:1). This gave **5b** as a colorless amorphous solid. TLC n-heptane-ethyl acetate (1:1). $R_f = 0.5$. $C_{26}H_{28}FNO_5$ (453.52) MS(ESI): 454 (M + H^+).

(+)-cis-2-(3-(2-(4-Fluorophenyl)oxazol-4-ylmethoxy)cyclohexyloxymethyl)-6-methylbenzoic acid **6b**



6b

[0132] 4.2 g (9.2 mmol) of **5b** were dissolved in 120 ml of t-BuOH. 50 ml of 50% aq. KOH were added, and the mixture was then boiled at 100°C for 24 hours. For work-up, the mixture was allowed to cool and then diluted with 100 ml of ethyl acetate. The aqueous phase was made slightly acidic by addition of 2 N aqueous HCl and extracted 2 more times with 100 ml of ethyl acetate. The organic phase was dried over $MgSO_4$, filtered and concentrated, and the residue was purified by flash chromatography (methylene chloride/methanol/conc. ammonia, 30/5/1). This gave **6b** as a white amorphous solid. TLC (methylene chloride/methanol/conc. ammonia, 30/5/1). $R_f = 0.3$. Recrystallization from toluene. $C_{25}H_{26}FNO_5$ (432.42) MS(ESI): 433 (M + H^+).

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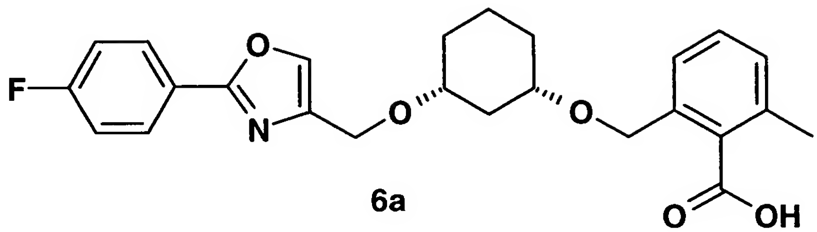
EXAMPLE III

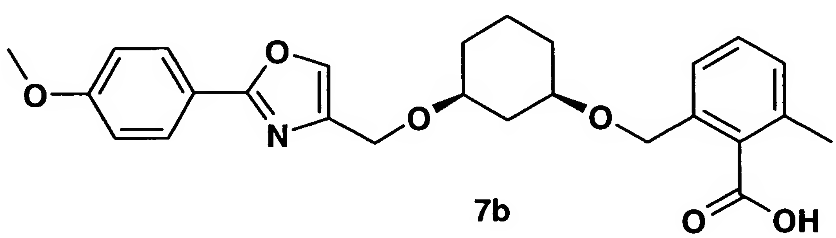


6a

(-)-cis-2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methyl-benzoic acid **6a**

[0133] Using **(+)3a** and methyl 2-bromomethyl-6-methylbenzoate **4** as starting materials in the procedure of Example I gave the product **6a** of molecular weight 432.42 ($C_{25}H_{26}FNO_5$); MS(ESI): 433 ($M + H^+$).

EXAMPLE IV



7b

cis-2-(3-(2-(4-Methoxyphenyl)oxazol-4-ylmethoxy)cyclohexyloxymethyl)-6-methylbenzoic acid **7b**

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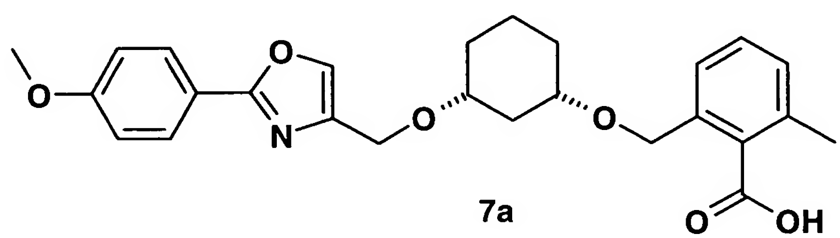
[0134] 170 mg (0.39 mmol) of **6b** were heated in 4 ml of 5.6 M NaOMe/MeOH solution at an oil bath temperature of 120 °C for 20 hours. Ethyl acetate and 2 N HCl were added, and the mixture was then worked up analogously to the synthesis of **6b**. This gave **7b** as a colorless amorphous solid. TLC: (methylene chloride/-methanol/conc. ammonia, 30/5/1). R_f ~ 0.3. $C_{26}H_{29}NO_6$ (451.52) MS(ESI): 452 $(M + H^+)$.

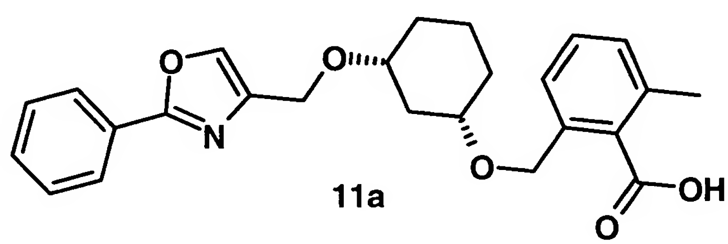
[0135] In the same manner, **6a** gave the stereoisomeric **7a**:



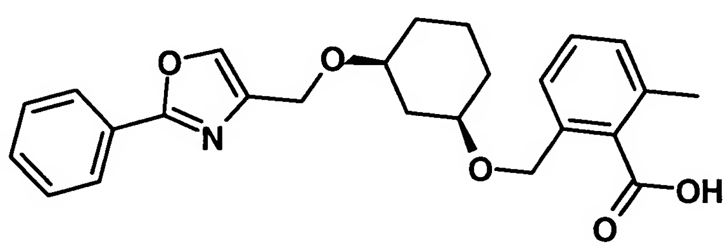
7a

TLC: (methylene chloride/methanol/conc. ammonia, 30/5/1). R_f ~ 0.3.
$C_{26}H_{29}NO_6$ (451.52) MS(ESI): 452 $(M + H^+)$.

EXAMPLE V (**11a**) and EXAMPLE VI (**11b**)



11a



11b

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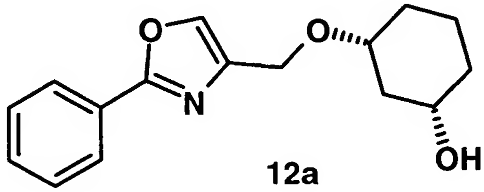
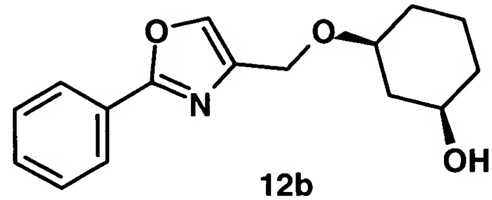
cis-3-(2-Phenyloxazol-4-ylmethoxy)cyclohexanol **12a,b**



12a

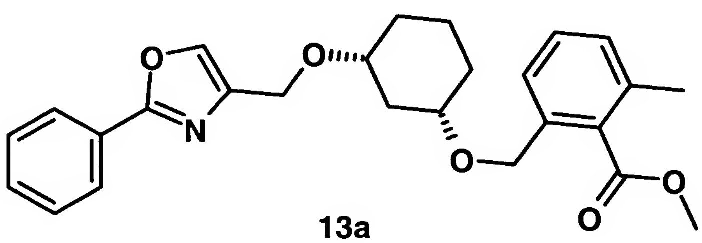


12b

[0136] 1,3-Cyclohexanediol and 4-iodomethyl-2-phenyloxazole gave the racemate **12** of molecular weight 273.33 ($C_{16}H_{19}NO_3$); MS(ESI): 274 ($M + H^+$).

[0137] The enantiomers were separated by HPLC on a chiral column. The (+)-enantiomer **12a** eluted first, followed by the (-)-enantiomer **12b** (Chiralpak OD 250x4.6; n-heptane:ethanol:acetonitrile = 110:2:1 + 0.05% trifluoroacetic acid).

Methyl cis-2-methyl-6-[3-(2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]-benzoate **13a**



13a

[0138] **12a** and methyl 2-bromomethyl-6-methylbenzoate gave **13a** of molecular weight 435.52 ($C_{26}H_{29}NO_5$); MS(ESI): 436 ($M + H^+$).

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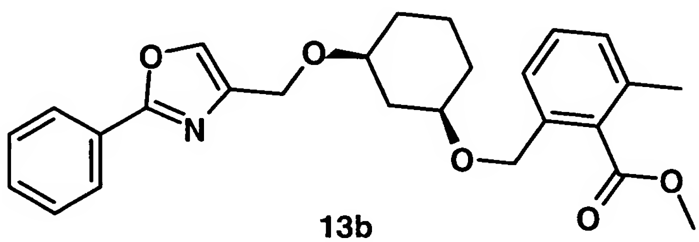
Methyl cis-2-methyl-6-[3-(2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]-benzoate **13b**



13b

12b and methyl 2-bromomethyl-6-methylbenzoate gave **13b** of molecular weight 435.52 ($C_{26}H_{29}NO_5$); MS(ESI): 436 (M + H^+).

cis-2-Methyl-6-[3-(2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **11a**

[0139] Hydrolysis of **13a** gave **11a** of molecular weight 421.50 ($C_{25}H_{27}NO_5$); MS(ESI): 422 (M + H^+).

cis-2-Methyl-6-[3-(2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **11b**

[0140] Analogously by hydrolysis, **13b** gave **11b** of molecular weight 421.50 ($C_{25}H_{27}NO_5$); MS(ESI): 422 (M + H^+).

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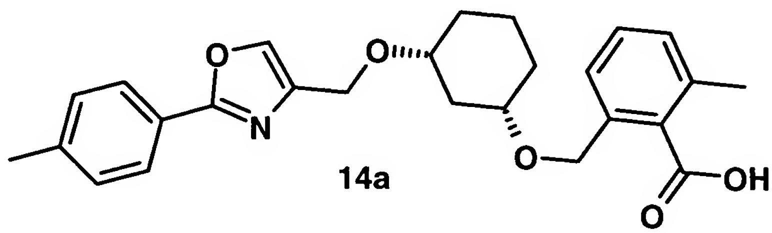
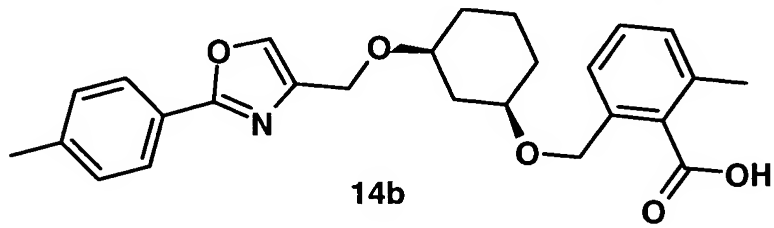
EXAMPLE VII (**14a**) and EXAMPLE VIII (**14b**)

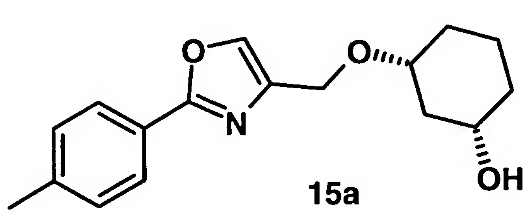


14a

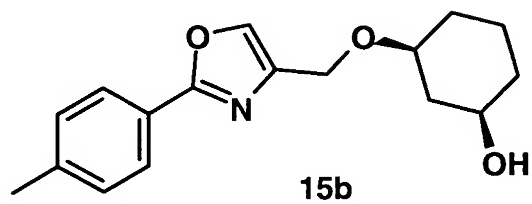


14b

cis-3-(2-p-Tolyloxazol-4-ylmethoxy)cyclohexanol **15a,b**



15a



15b

[0141] Cyclohexanediol and 4-iodomethyl-2-p-tolyloxazole gave the racemate **15** of molecular weight 287.36 ($C_{17}H_{21}NO_3$); MS(ESI): 288 (M + H^+).

[0142] Separation of the enantiomers was carried out by HPLC on a chiral column. The (+)-enantiomer **15a** eluted first, followed by the (-)-enantiomer **15b** (Chiralpak OD 250x4.6; n-heptane:ethanol:acetonitrile = 110:5:1 + 0.05% trifluoroacetic acid).

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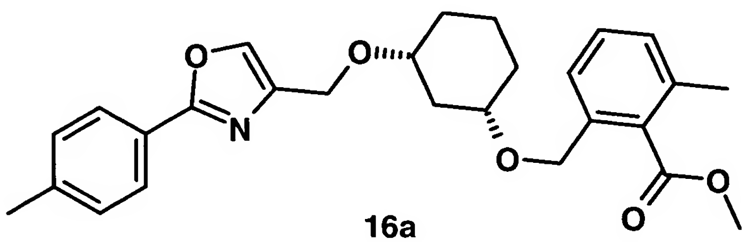
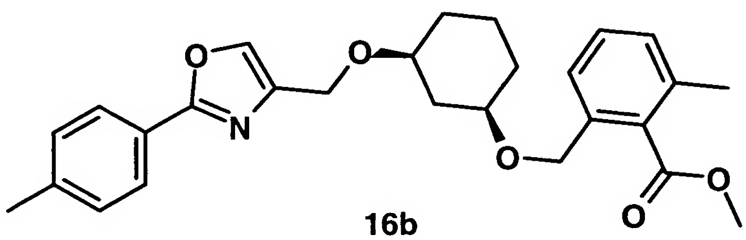
Methyl cis-2-methyl-6-[3-(2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]-benzoate **16a**



16a

[0143] **15a** and methyl 2-bromomethyl-6-methylbenzoate gave **16a** of molecular weight 449.55 ($C_{27}H_{31}NO_5$); MS(ESI): 450 (M + H^+).

Methyl cis-2-methyl-6-[3-(2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoate **16b**



16b

[0144] **15b** and methyl 2-bromomethyl-6-methylbenzoate gave **16b** of molecular weight 449.55 ($C_{27}H_{31}NO_5$); MS(ESI): 450 (M + H^+).

cis-2-Methyl-6-[3-(2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **14a**

[0145] **16a** gave **14a** of molecular weight 435.52 ($C_{26}H_{29}NO_5$); MS(ESI): 436 (M + H^+).

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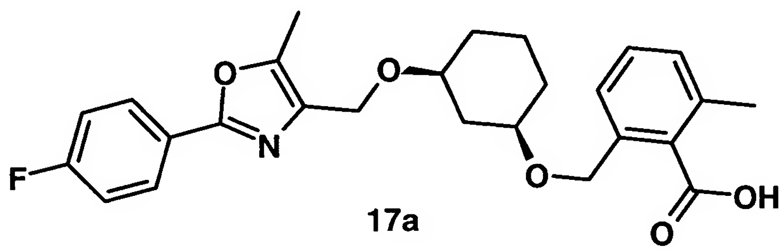
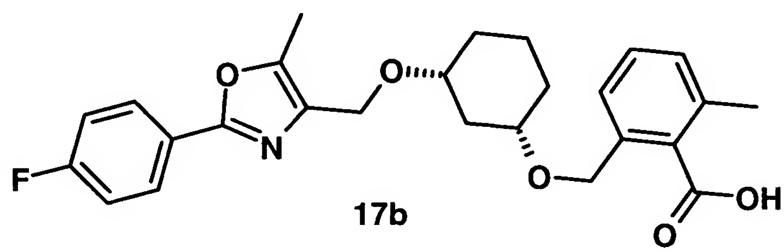
cis-2-Methyl-6-[3-(2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **14b**

[0146] **16b** gave the product **14b** of molecular weight 435.52 ($C_{26}H_{29}NO_5$); MS(ESI): 436 (M + H^+).

EXAMPLE IX (**17a**) and EXAMPLE X (**17b**)

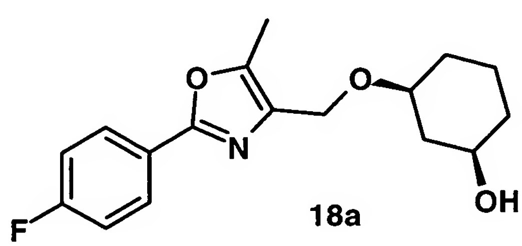


17a

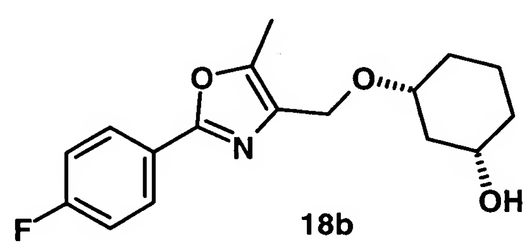


17b

cis-3-[2-(4-Fluorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexanol **18a,b**



18a



18b

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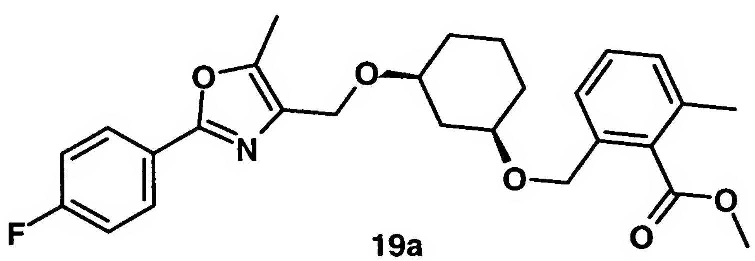
[0147] Cyclohexanediol and 2-(4-fluorophenyl)-4-iodomethyl-5-methyloxazole gave the racemate **18** of molecular weight 305.35 ($C_{17}H_{20}FNO_3$); MS(ESI): 306 (M + H^+).

[0148] The enantiomers were separated by HPLC on a chiral column. The (+)-enantiomer **18a** eluted first, followed by the (-)-enantiomer **18b** (Chiralpak OD 250x4.6; n-heptane:ethanol:acetonitrile = 110:2:1 + 0.05% trifluoroacetic acid).

Methyl cis-2-{3-[2-(4-fluorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoate **19a**



19a

[0149] **18a** and methyl 2-bromomethyl-6-methylbenzoate gave **19a** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 (M + H^+).

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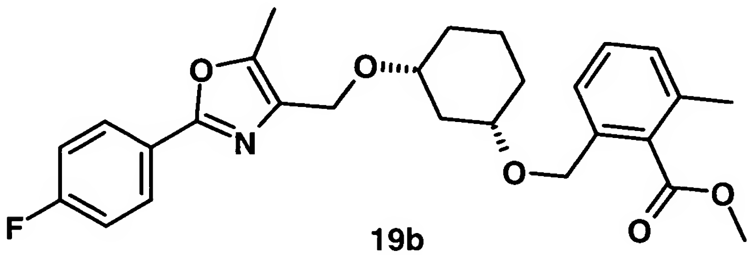
Methyl cis-2-{3-[2-(4-fluorophenyl)-5-methyloxazol-4-ylmethoxy]-cyclohexyloxymethyl}-6-methylbenzoate **19b**



19b

[0150] **18b** and methyl 2-bromomethyl-6-methylbenzoate gave **19b** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 (M + H^+).

cis-2-(3-[2-(4-Fluorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **17a**

[0151] Hydrolysis of **19a** gave **17a** of molecular weight 453.52 ($C_{26}H_{28}FNO_5$); MS(ESI): 454 (M + H^+).

cis-2-{3-[2-(4-Fluorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **17b**

[0152] Analogously by hydrolysis, **19b** gave **17b** of molecular weight 453.52 ($C_{26}H_{28}FNO_5$); MS(ESI): 454 (M + H^+).

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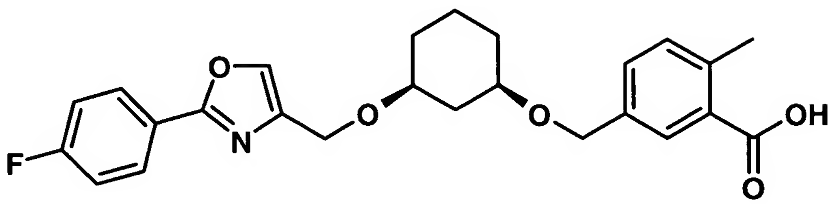
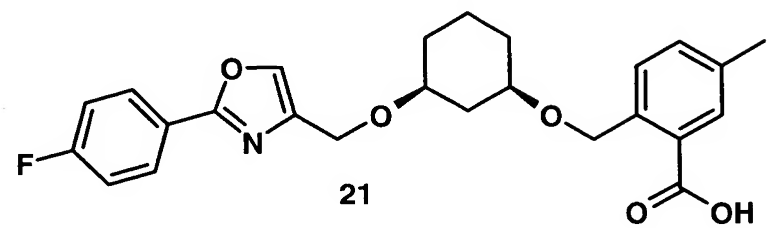
EXAMPLE XI (**20**) and EXAMPLE XII (**21**)

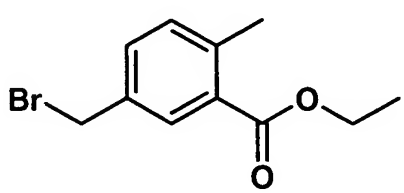


20

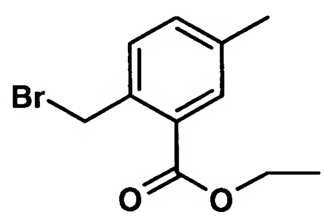


21

Ethyl 5-bromomethyl-2-methylbenzoate **22** and
ethyl 2-bromomethyl-5-methylbenzoate **23**



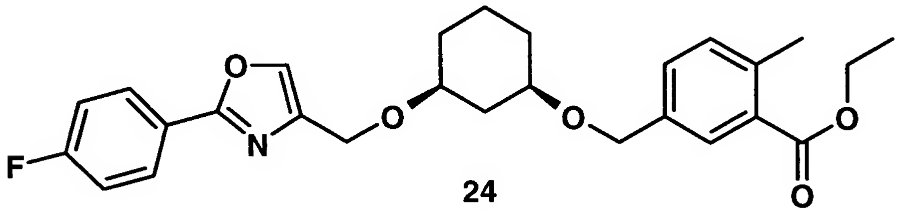
22



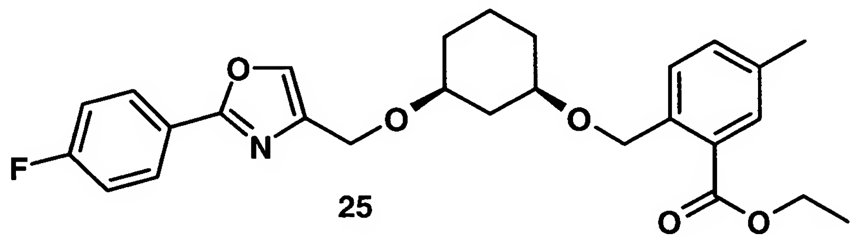
23

[0153] A solution of 3.5 g of ethyl 2,5-dimethylbenzoate, 3.15 g of N-bromosuccinimide and 100 ml of carbon tetrachloride was, for 3 hours, heated under reflux and irradiated with a 300 watt photolamp. The resulting precipitate was filtered off and the concentrated filtrate was chromatographed on silica gel. This gave an approximately 2:3 (**22:23**) mixture of the regioisomeric benzyl bromides **22** and **23** of molecular weight 257.13 ($C_{11}H_{13}BrO_2$); MS (ESI): 257 ($M + H^+$).

Ethyl rac-cis-5-{3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-2-methylbenzoate **24** and ethyl rac-cis-2-{3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-5-methylbenzoate **25**



24



25

[0154] At 0°C, a solution of 150 mg of rac-cis-3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]-cyclohexanol **3a** in 0.5 ml of dimethylformamide was added dropwise to a suspension of 40 mg of sodium hydride (55-65% in paraffin oil) in 1 ml of dimethylformamide. After the evolution of gas ceased, 198 mg of 2:3 mixture of ethyl 5-bromomethyl-2-methylbenzoate **22** and ethyl 2-bromomethyl-5-methyl-benzoate **23** were added. After 30 minutes at 0°C, the mixture was allowed to react for a further 1 hour at room temperature. The mixture was poured into an ammonium chloride solution and extracted twice with MTBE. The extracts were dried over magnesium sulfate, filtered and concentrated using a rotary evaporator, and the product was then purified by silica gel chromatography (mobile phase: n-heptane/ethyl acetate 3:1). This gave the faster eluting product ethyl rac-cis-2-{3-

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[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-5-methylbenzoate **25** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS (ESI): 468 (M + H^+).

[0155] Also isolated was the later eluting product ethyl rac-cis-5-{3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-2-methylbenzoate **24** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS (ESI): 468 (M + H^+).

rac-cis-5-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-2-methylbenzoic acid **20**

[0156] A suspension of 47 mg of ethyl rac-cis-5-{3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-2-methylbenzoate **24**, 2 ml of 1,1-dimethylethanol and 50% (w/w) potassium hydroxide was heated at 85°C (oil bath) for 2 hours. The pH was adjusted to 3 using dilute hydrochloric acid and the mixture was extracted twice with MTBE. The extracts were dried over magnesium sulfate, filtered and concentrated on a rotary evaporator, and the product was then purified by chromatography. This gave the product **20** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS (ESI): 440 (M + H^+).

[0157] Using a different starting material in the procedure for making **20**:

rac-cis-2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-5-methylbenzoic acid **21**

was prepared from ethyl rac-cis-2-{3-[2-(4-fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-5-methylbenzoate **25**.

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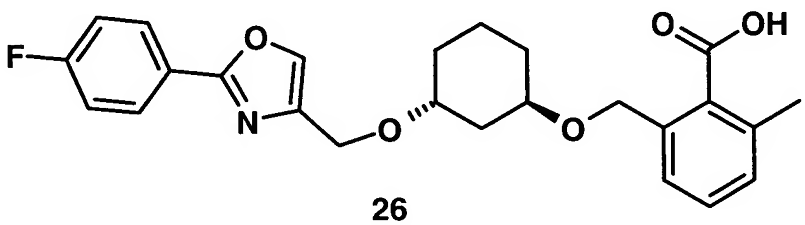
EXAMPLE XIII

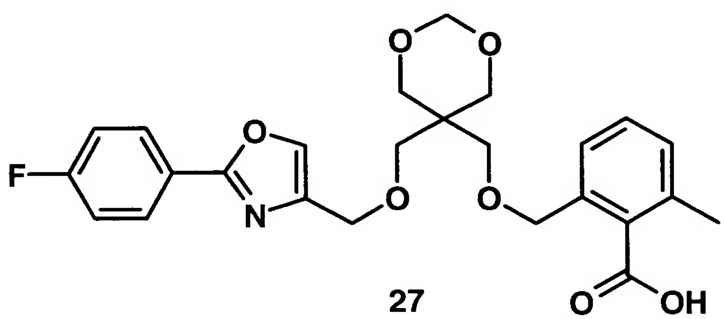
rac-trans-2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **26**



26

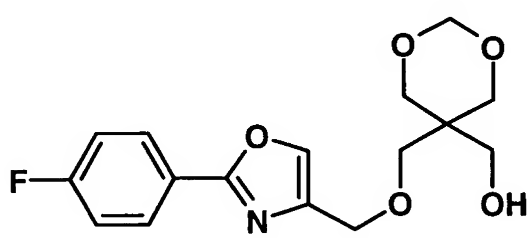
[0158] rac-trans **3b** and methyl 2-bromomethyl-6-methylbenzoate gave the product **26** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS(ESI): 440 ($M + H^+$).

EXAMPLE XIV



27

5-(2-(4-Fluorophenyl)oxazol-4-ylmethoxymethyl)-1,3-dioxan-5-ylmethanol **28**



28

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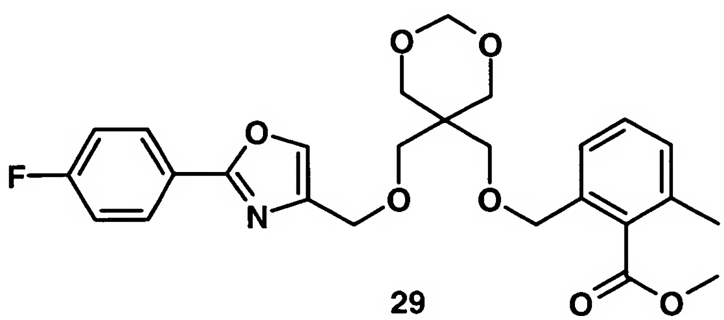
[0159] 1.0 g (6.7 mmol) of 5-hydroxymethyl-1,3-dioxan-5-ylmethanol and 0.5 g (16.5 mmol) of **2** were dissolved in 20 ml of dry DMF. 300 mg of 55% NaH in paraffin oil were added, and the mixture was then stirred at room temperature for 1 hour. Work-up was carried out analogously to the synthesis of compound **5b**. This gave **28** as a white amorphous solid. TLC (n-heptane/ethyl acetate 1:2). $R_f = 0.4$. $C_{16}H_{18}FNO_5$ (323.33) MS(ESI) 324.2 $(M + H^+)$.

Methyl 2-{5-[2-(4-fluorophenyl)oxazol-4-ylmethoxymethyl]-1,3-dioxan-5-ylmethoxymethyl}-6-methylbenzoate **29**



29

[0160] Using **28** and **4** as starting materials in the synthesis procedure of **5b** of Example II gave compound **29**.

2-{5-[2-(4-Fluorophenyl)oxazol-4-ylmethoxymethyl]-1,3-dioxan-5-ylmethoxymethyl}-6-methylbenzoic acid **27**

[0161] Using **29** as a starting material in the synthesis procedure for **6b** of Example II gave compound **27** by hydrolysis.

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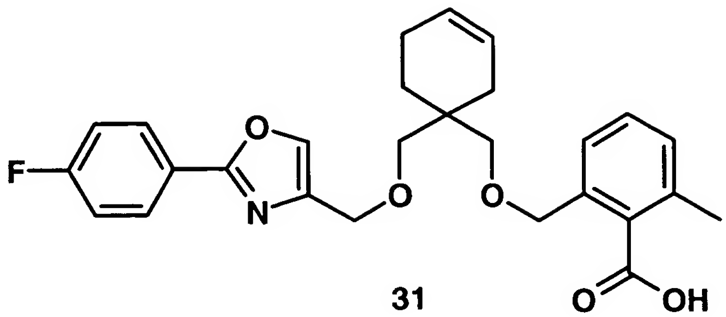
EXAMPLE XV

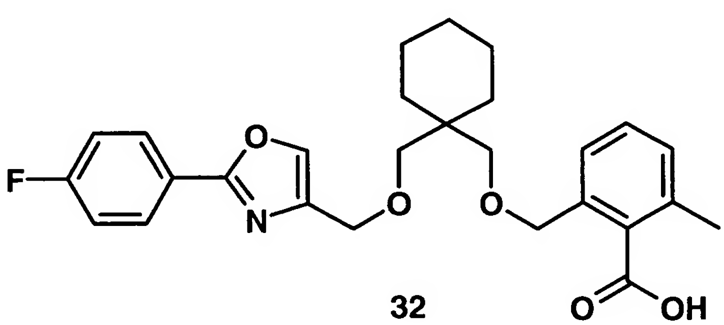


31

2-{1-[2-(4-Fluorophenyl)oxazol-4-ylmethoxymethyl]cyclohex-3-enylmethoxymethyl}-6-methylbenzoic acid **31**

[0162] Using (1-hydroxymethylcyclohex-3-enyl)methanol, iodide **2** and bromide **4** as starting materials in the procedure of Example XIV, gave the product **31** of molecular weight 465.53 ($C_{27}H_{28}FNO_5$); MS(ESI): 466 (M + H^+).

EXAMPLE XVI



32

2-{1-[2-(4-Fluorophenyl)oxazol-4-ylmethoxymethyl]cyclohexylmethoxymethyl}-6-methylbenzoic acid **32**

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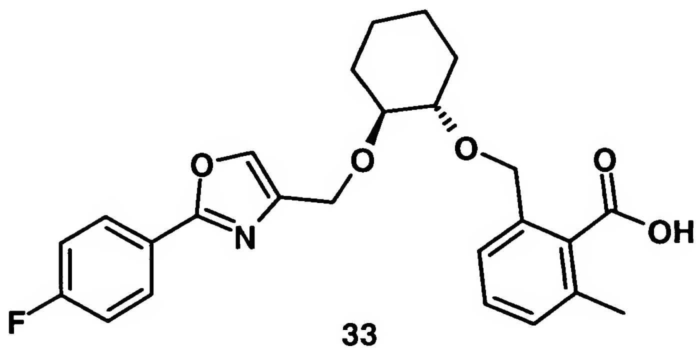
[0163] Using (1-hydroxymethylcyclohexyl)methanol, iodide **2**, and bromide **4** as reactants in the procedure of Example XIV gave the product **32** of molecular weight 467.53 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 ($M + H^+$).

EXAMPLE XVII



33

rac-trans-2-{2-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **33**

[0164] Using trans-1,2-dihydroxycyclohexanol, iodide **2** and bromide **4** as starting materials in the synthesis procedure of Example XIV, gave the desired product **33** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS(ESI): 440 ($M + H^+$).

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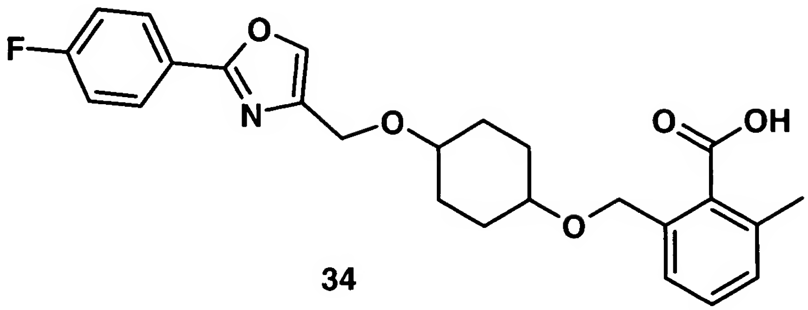
EXAMPLE XVIII

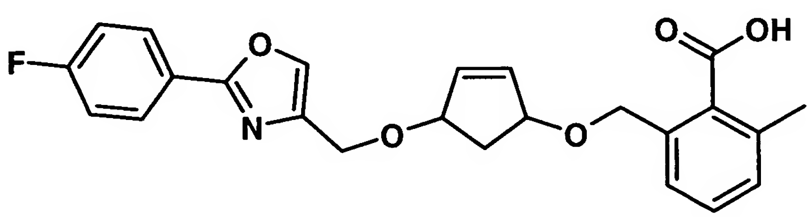


34

2-{4-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **34**

[0165] 1,4-Cyclohexanediol, iodide **2** and bromide **4** gave product **34** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS(ESI): 440 ($M + H^+$).

EXAMPLE XIX



35

2-{4-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclopent-2-enyloxymethyl}-6-methylbenzoic acid **35**

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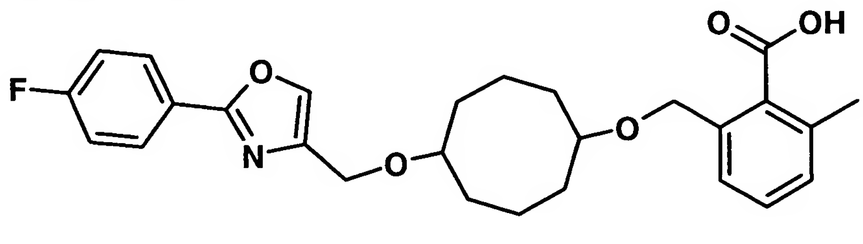
[0166] Cyclopent-2-ene-1,4-diol, iodide **2** and bromide **4** gave the product **35** of molecular weight 423.45 ($C_{24}H_{22}FNO_5$); MS(ESI): 424 ($M + H^+$).

EXAMPLE XX

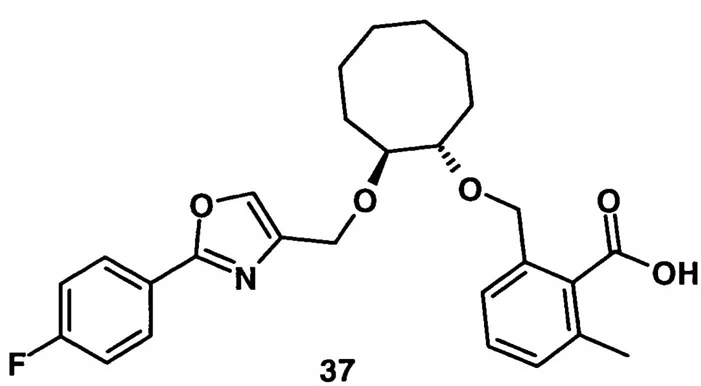


36

2-{5-[2-(4-Fluorophenyl)oxazol-4-ymethoxy]cyclooctyloxymethyl}-6-methylbenzoic acid **36**

[0167] 1,5-Cyclooctanediol, iodide **2** and bromide **4** gave product **36** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 ($M + H^+$).

EXAMPLE XXI



37

rac-trans-2-{2-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclooctyloxymethyl}-6-methylbenzoic acid **37**

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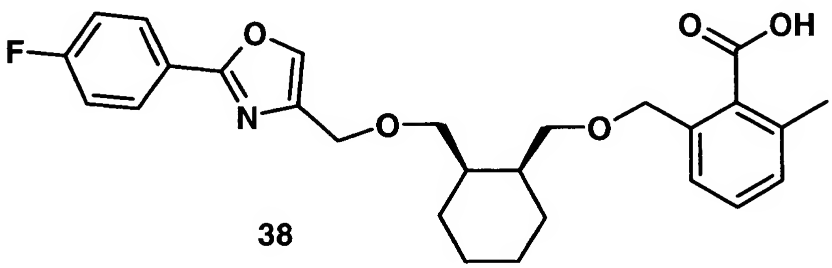
[0168] trans-1,2-Cyclooctanediol, iodide **2** and bromide **4** gave the desired product **37** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 (M + H^+).

EXAMPLE XXII

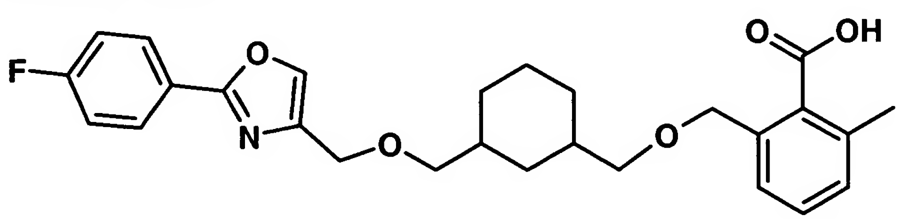


38

rac-cis-2-{2-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]methylcyclohexyl-methoxymethyl}-6-methylbenzoic acid **38**

[0169] cis-(2-Hydroxymethylcyclohexyl)methanol, iodide **2** and bromide **4** gave the product **38** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 (M + H^+).

EXAMPLE XXIII



39

2-{2-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]methylcyclohexylmethoxymethyl}-6-methylbenzoic acid **39**

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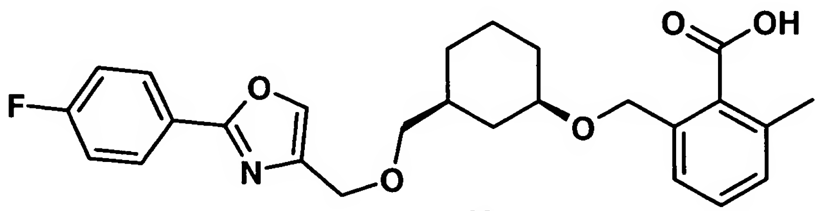
[0170] (3-Hydroxymethylcyclohexyl)methanol, iodide **2** and bromide **4** gave the product **39** of molecular weight 467.54 ($C_{27}H_{30}FNO_5$); MS(ESI): 468 ($M + H^+$).

EXAMPLE XXIV

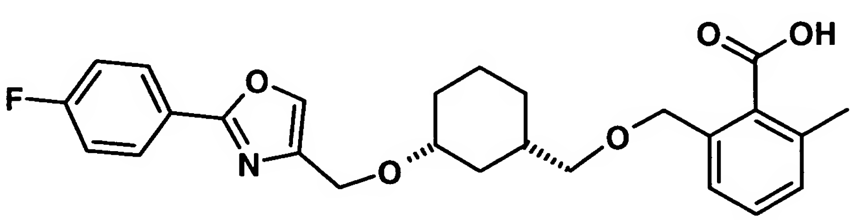


40

rac-cis-2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxymethyl]cyclohexyloxymethyl}-6-methylbenzoic acid **40**

[0171] cis-3-Hydroxymethylcyclohexanol, iodide **2** and bromide **4** gave product **40** of molecular weight 453.52 ($C_{26}H_{28}FNO_5$); MS(ESI): 454 ($M + H^+$).

EXAMPLE XXV



41

rac-cis-2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexylmethoxymethyl}-6-methylbenzoic acid **41**

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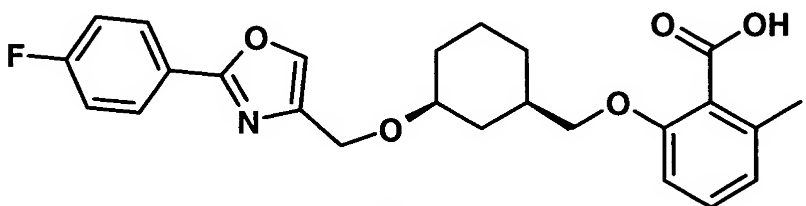
[0172] Reacting cis-3-hydroxymethylcyclohexanol, bromide **4** and iodide **2** in a reverse order relative to Example XXIV gave the product **41** of molecular weight 453.52 ($C_{26}H_{28}FNO_5$); MS(ESI): 454 (M + H^+).

EXAMPLE XXVI

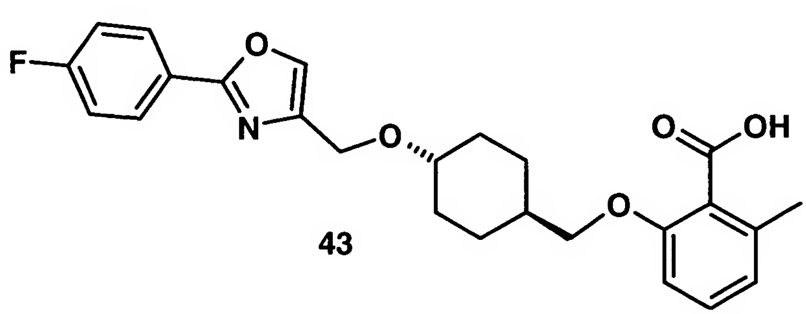


42

rac-cis-2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexylmethoxy}-6-methylbenzoic acid **42**

[0173] cis-3-Hydroxymethylcyclohexanol, iodide **2** and ethyl 2-hydroxy-6-methylbenzoate gave the product **42** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS(ESI): 440 (M + H^+).

EXAMPLE XXVII



43

rac-trans-2-{4-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexylmethoxy}-6-methylbenzoic acid **43**

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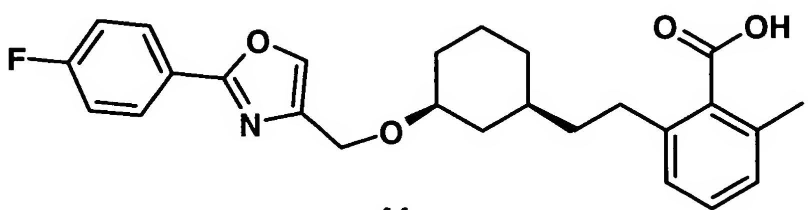
[0174] trans-4-Hydroxymethylcyclohexanol, iodide **2** and ethyl 2-hydroxy-6-methylbenzoate gave the product **43** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS(ESI): 440 (M + H^+).

EXAMPLE XXVIII

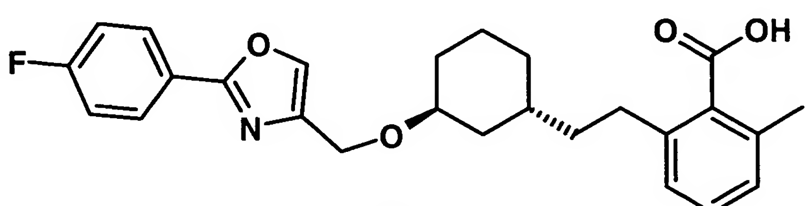


44

rac-cis-2-(2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyl}ethyl)-6-methylbenzoic acid **44**

[0175] cis-3-Ethynylcyclohex-2-enol, ethyl 2-methyl-6-trifluoromethanesulfonyloxybenzoate and iodide **2** gave the product **44** of molecular weight 437.52 ($C_{26}H_{28}FNO_4$); MS(ESI): 438 (M + H^+).

EXAMPLE XXIX



45

rac-trans-2-(2-{3-[2-(4-Fluorophenyl)oxazol-4-ylmethoxy]cyclohexyl}ethyl)-6-methylbenzoic acid **45**

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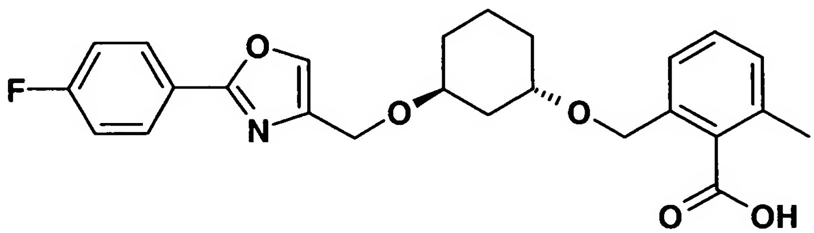
[0176] trans-3-Ethynylcyclohex-2-enol, ethyl 2-methyl-6-trifluoromethanesulfonyloxybenzoate and iodide **2** gave the product **45** of molecular weight 437.52 ($C_{26}H_{28}FNO_4$); MS(ESI): 438 ($M + H^+$).

EXAMPLE XXX



46

rac-trans-2-(3-(2-(4-Fluorophenyl)oxazol-4-ylmethoxy)cyclohexyloxymethyl)-6-methylbenzoic acid **46**

[0177] The racemic trans-enantiomer mixture **3b** (see Example I) and methyl 2-bromomethyl-6-methylbenzoate **4** gave the desired product **46** of molecular weight 439.49 ($C_{25}H_{26}FNO_5$); MS(ESI): 440 ($M + H^+$).

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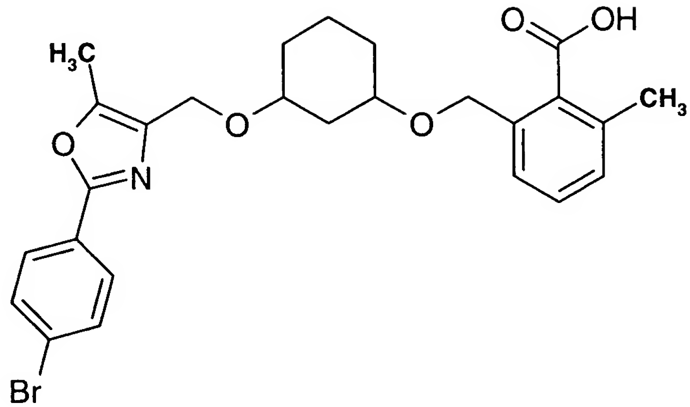
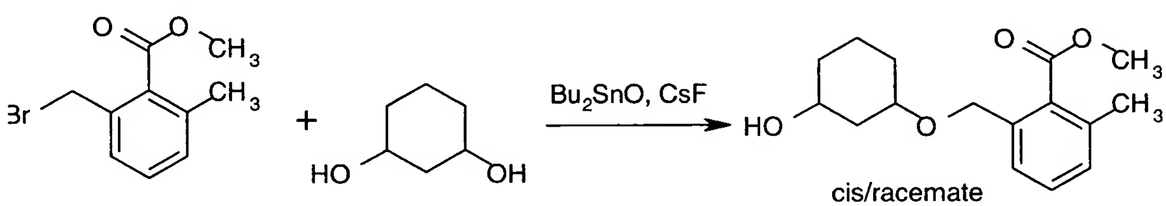
EXAMPLE XXXI



50

Methyl 2-(cis-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate **47** and methyl 2-(trans-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate **48**



[0178] 8.7 g 1,3-cyclohexanediol and 12 g dibutyltin oxide were dissolved in 600 ml of toluene and, under reflux on a water separator, heated to boiling. During the reaction, the reaction volume was reduced to half of the original volume. After 4 hours, the reaction mixture was cooled to room temperature, and 300 ml of DMF, 9.0 g of methyl 2-bromomethyl-6-methylbenzoate and 9.4 g of cesium fluoride were added. The mixture was stirred at room temperature for 12 hours. The reaction mixture was diluted by addition of ethyl acetate and washed with saturated NaCl solution. The organic phase was dried over magnesium sulfate, the solvent was removed under reduced pressure and the residue was purified by flash

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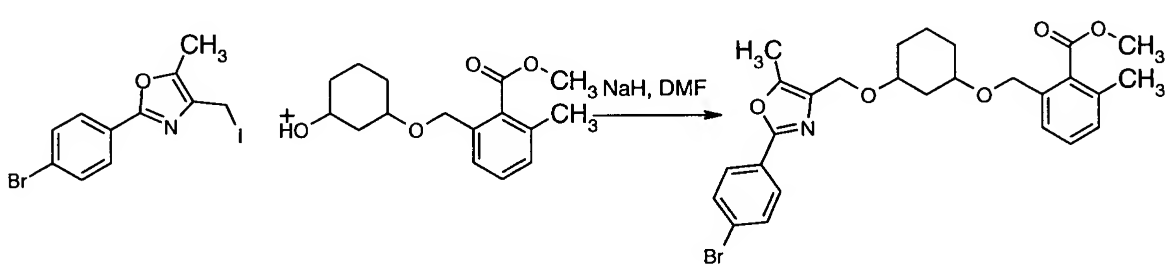
chromatography on silica gel (n-heptane/ethyl acetate = 50:1 → 1:2). This gave about 6 g of the alcohol **47** (cis-racemate) as an oil. $C_{16}H_{22}O_4$ (278.35), MS(ESI): 279 (M + H^+). The unreacted trans-1,3-cyclohexanediol also eluted from the chromatography column. It was alkylated analogously to Example I using sodium hydride and methyl 2-bromomethyl-6-methylbenzoate. After analogous work-up and chromatography as described for the cis-racemate, the trans-racemate **48** was obtained $C_{16}H_{22}O_4$ (278.35), MS(ESI): 279 (M + H^+).

[0179] Racemates **47** and **48** were separated by chromatography on a chiral phase (Chiralpak AD/2 250x4.6; n-heptane:ethanol:methanol = 25:1:0.5 + 0.1 % trifluoroacetic acid, R_t (**47a**) = 8.9 min; retention time of the enantiomer: R_t (**47b**) = 9.9 min (the absolute retention times varied with the exact chromatography conditions)).

[0180] The reactions described below can be carried out both with the pure stereoisomers and with mixtures of the stereoisomers.

[0181] Methyl 2-{3-[2-(4-bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoate **49**



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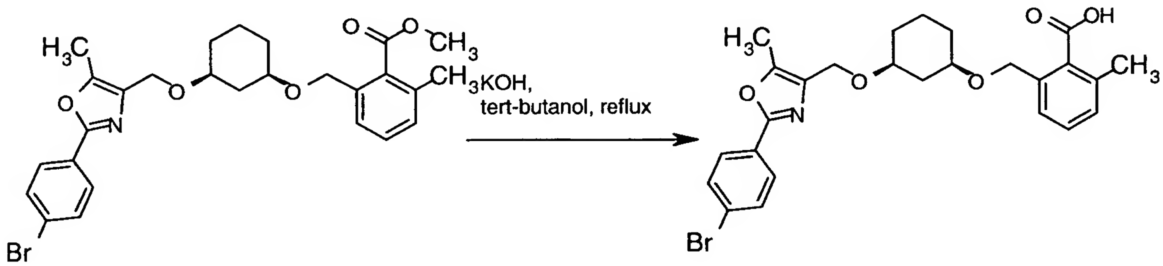
[0182] At room temperature, 50 mg of a 60% sodium hydride suspension and then 408 mg of 2-(4-bromophenyl)-4-iodomethyl-5-methyloxazole were added to a solution of 200 mg of methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate in 5 ml of dimethylformamide. After one hour, methyl tert-butyl ether was added, and the mixture was extracted with water. The organic phase was dried over magnesium sulfate, the solvents were removed under reduced pressure and the residue was purified by RP-HPLC. This gave **49** as a light-yellow oil. $C_{27}H_{30}BrNO_5$ (528.45), MS(ESI): 528.2, 530.2 (M + H^+).

2-{3-[2-(4-Bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **50**



49 **50**

[0183] 117 mg of **49** were stirred in a mixture of 10 ml of tert-butanol and 1 ml of 10 N aqueous potassium hydroxide solution at 90°C. After two days, the mixture was acidified with hydrochloric acid and extracted with ethyl acetate. The combined organic phases were dried over magnesium sulfate, the solvents were removed

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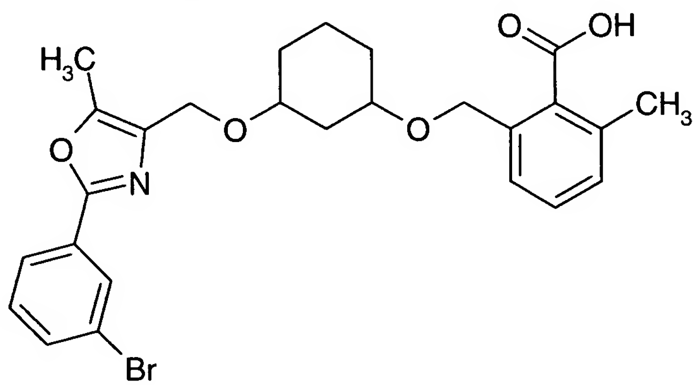
under reduced pressure and the residue was purified by RP-HPLC. This gave **50** as an amorphous solid. $C_{26}H_{28}BrNO_5$ (514.52), MS(ESI): 514.29, 516.29 (M + H^+).

EXAMPLE XXXII

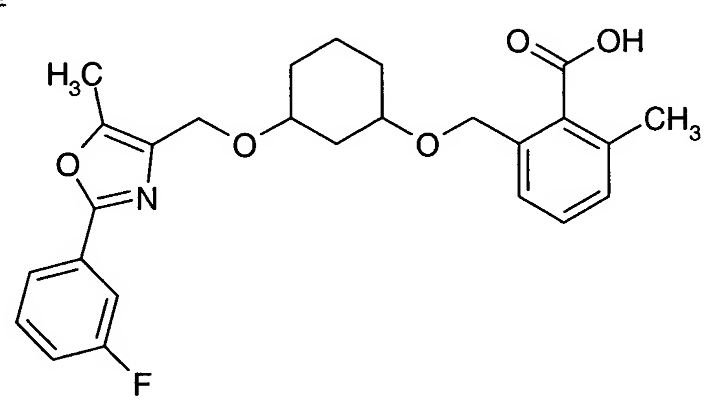


51

2-{3-[2-(3-Bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **51**

[0184] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-bromophenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **51** of molecular weight 514.42, ($C_{26}H_{28}BrNO_5$), MS(ESI): 514.30, 516.30 (M + H^+).

EXAMPLE XXXIII



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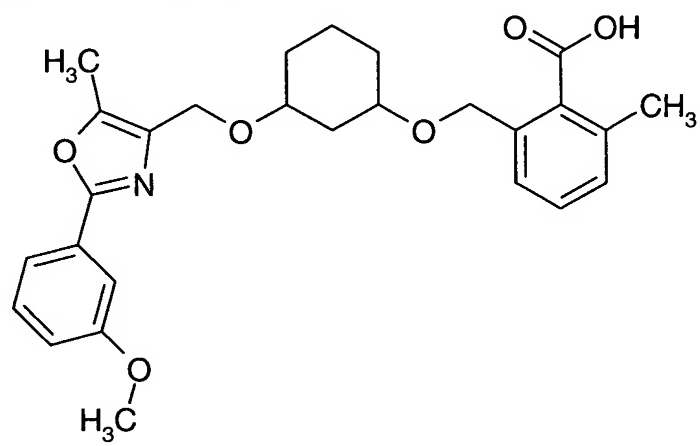
52

2-{3-[2-(3-Fluorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **52**

[0185] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-fluorophenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **52** of molecular weight 453.52 ($C_{26}H_{28}FNO_5$), MS(ESI): 454.35 ($M + H^+$).

EXAMPLE XXXIV



53

2-{3-[2-(3-Methoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **53**

[0186] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-methoxyphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the

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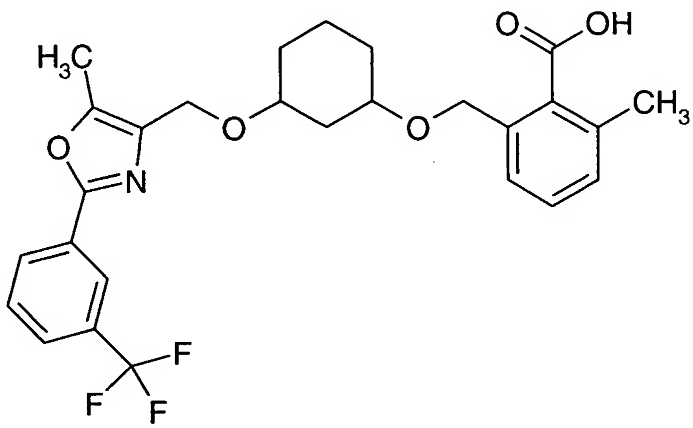
procedure of Example XXXI, gave the product **53** of molecular weight 465.55 ($C_{27}H_{31}NO_6$), MS(ESI): 466.37 ($M + H^+$).

EXAMPLE XXXV



54

2-{3-[2-(3-Trifluoromethylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **54**

[0187] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-trifluoromethylphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **54** of molecular weight 503.52 ($C_{27}H_{28}F_3NO_5$), MS(ESI): 504.37 ($M + H^+$).

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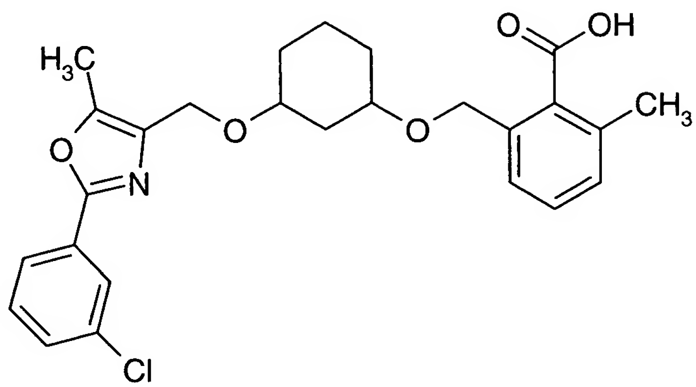
EXAMPLE XXXVI

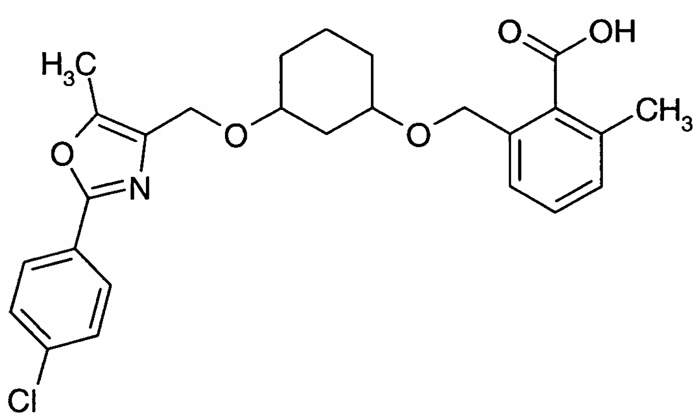


57

2-{3-[2-(3-Chlorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **57**

[0188] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-chlorophenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **57** of molecular weight 469.97 ($C_{26}H_{28}ClNO_5$), MS(ESI): 470.43 (M + H^+).

EXAMPLE XXXVII



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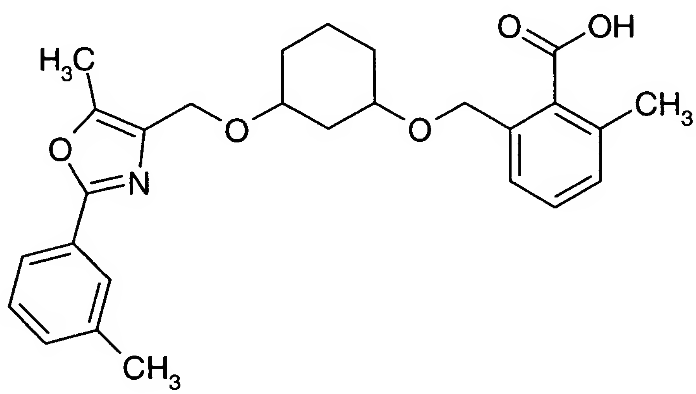
2-{3-[2-(4-Chlorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **58**

[0189] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-chlorophenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, the product **58** of molecular weight 469.97 ($C_{26}H_{28}ClNO_5$), MS(ESI): 470.40 (M + H^+).

EXAMPLE XXXVIII



59

2-{3-[2-(3-Methylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **59**

[0190] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-methylphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **59** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.53 (M + H^+).

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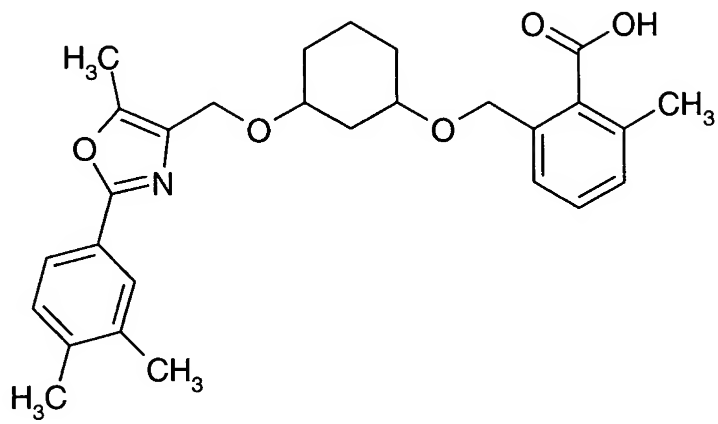
EXAMPLE XXXIX

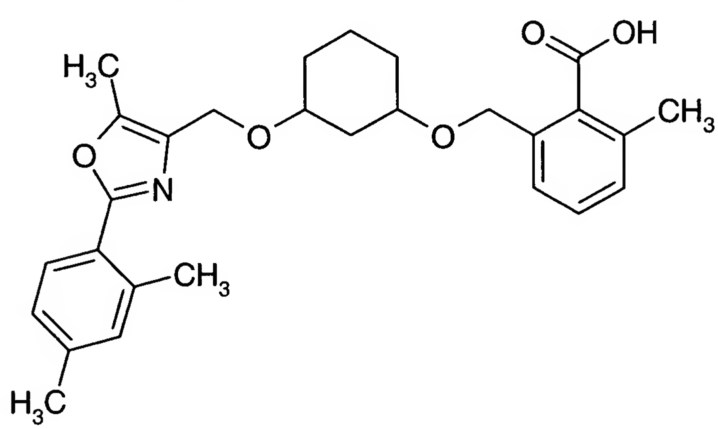


61

2-{3-[2-(3,4-Dimethylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **61**

[0191] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3,4-dimethylphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **61** of molecular weight 463.58 ($C_{28}H_{33}NO_5$), MS(ESI): 464.22 (M + H^+).

EXAMPLE XL



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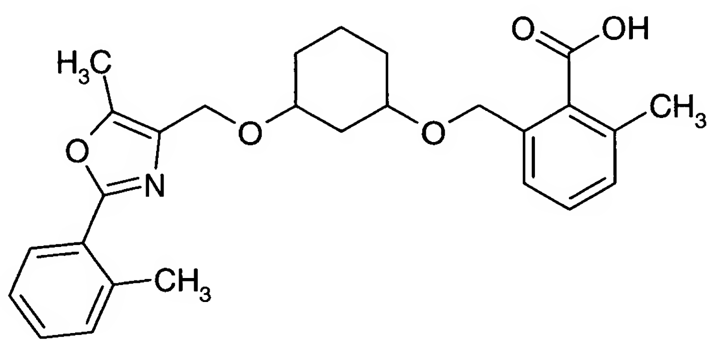
2-{3-[2-(2,4-Dimethylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **62**

[0192] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(2,4-dimethylphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **62** of molecular weight 463.58 ($C_{28}H_{33}NO_5$), MS(ESI): 464.22 (M + H^+).

EXAMPLE XLI



63

2-{3-[2-(2-Methylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **63**

[0193] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(2-methylphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **63** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.20 (M + H^+).

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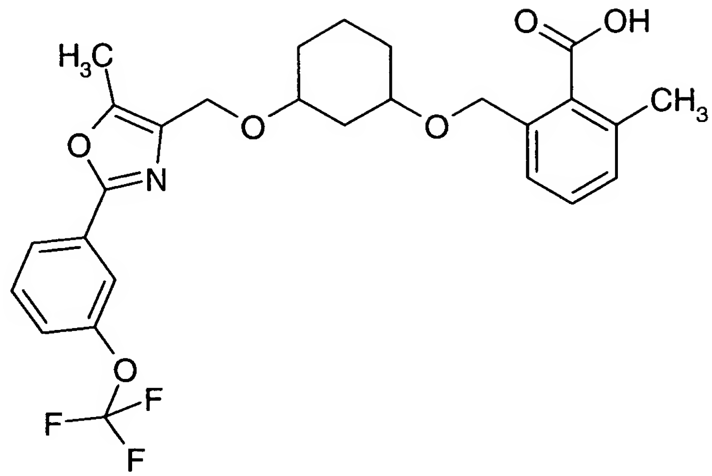
EXAMPLE XLII



64

2-{3-[2-(3-Trifluoromethoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **64**

[0194] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-trifluoromethoxyphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **64** of molecular weight 519.52 ($C_{27}H_{28}F_3NO_6$), MS(ESI): 520.20 (M + H^+).

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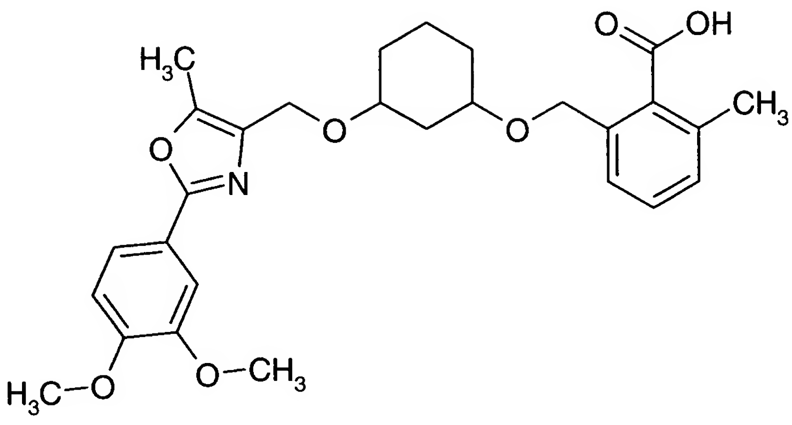
EXAMPLE XLIII

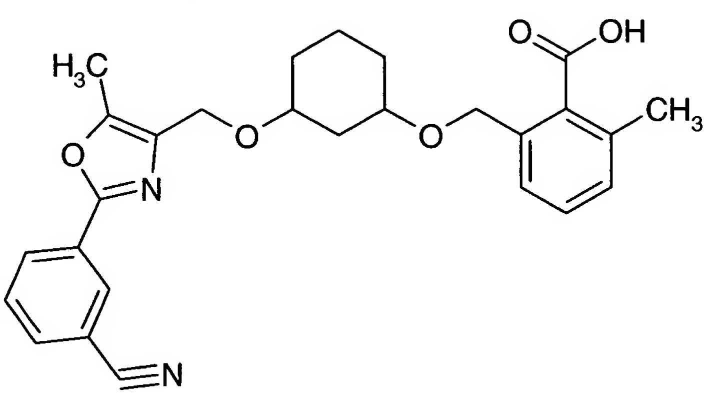


67

2-{3-[2-(3,4-Dimethoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **67**

[0195] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3,4-dimethoxyphenyl)-4-iodomethyl-5-methyloxazol as starting materials in the procedure of Example XXXI, gave the product **67** of molecular weight 495.58 ($C_{28}H_{33}NO_7$), MS(ESI): 496.20 ($M + H^+$).

EXAMPLE XLIV



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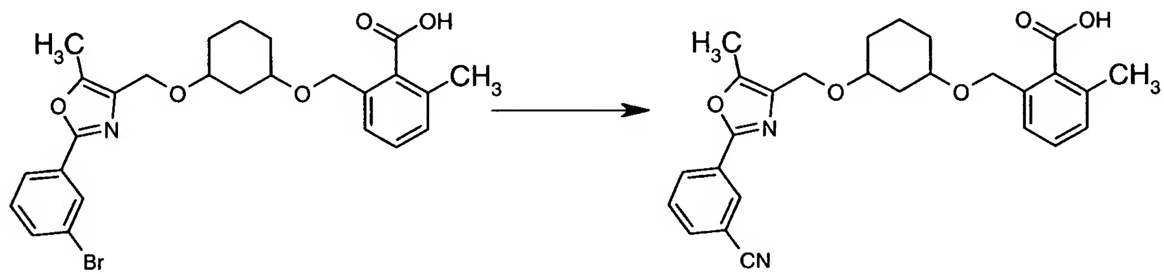
2-{3-[2-(3-Cyanophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **68**



68

[0196] 13 mg of 2-{3-[2-(3-bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid and 25 mg of zinc cyanide were dissolved in 5 ml of dimethylformamide. The reaction mixture was degassed and charged with argon, and 20 mg of tetrakistriphenylphosphinepalladium were added. The mixture was stirred at 100°C for 12 hours. After cooling to room temperature, water was added to the reaction mixture, which was then extracted with ethyl acetate. The combined organic phases were dried over magnesium sulfate, the solvents were removed under reduced pressure and the residue was purified by RP-HPLC. This gave **68** as an amorphous light-yellow solid. $C_{27}H_{28}N_2O_5$ (460.53), MS(ESI): 461.20 (M + H^+).

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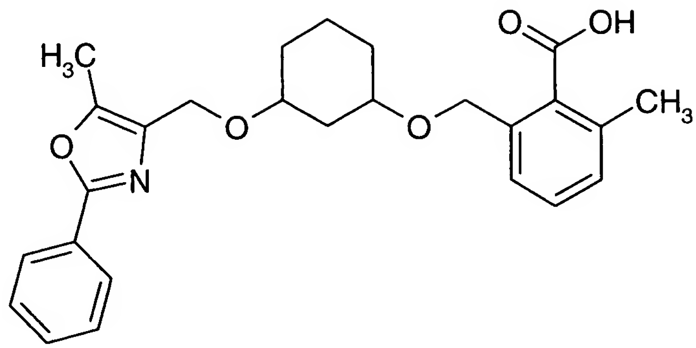
EXAMPLE XLV

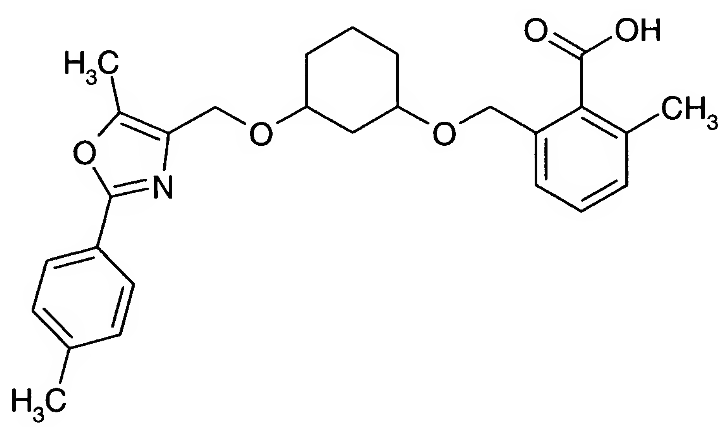


69

2-Methyl-6-[3-(5-methyl-2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **69**

[0197] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-phenyl-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **69** of molecular weight 435.52 ($C_{26}H_{29}NO_5$), MS(ESI): 436.32 ($M + H^+$).

EXAMPLE XLVI



70

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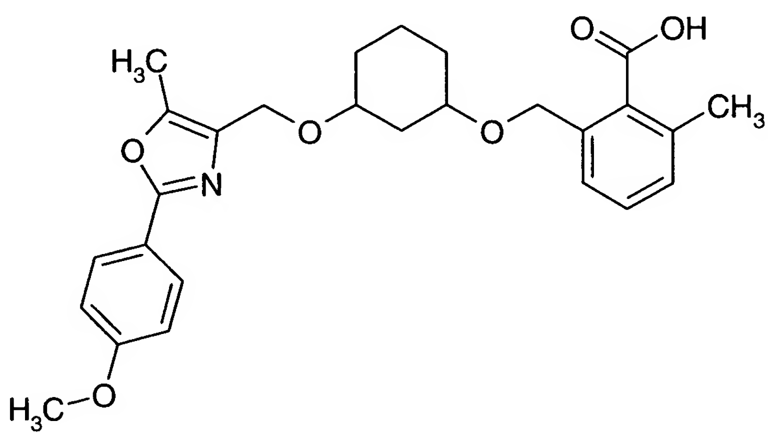
2-Methyl-6-[3-(5-methyl-2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **70**

[0198] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-methylphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the procedure of Example XXXI, gave the product **70** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.36 (M + H^+).

EXAMPLE XLVII



71

2-{3-[2-(4-Methoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **71**

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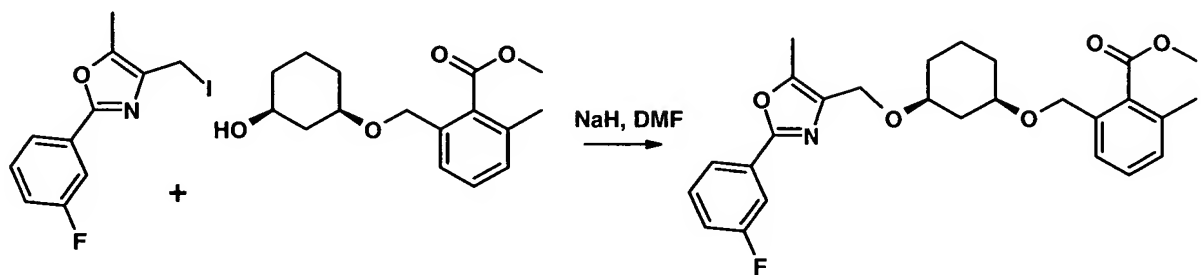
[0199] Using methyl 2-(3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-methoxyphenyl)-4-iodomethyl-5-methyloxazole as starting materials in the

procedure of Example XXXI, gave the product **71** of molecular weight 465.55 ($C_{27}H_{31}NO_6$), MS(ESI): 466.37 ($M + H^+$).

EXAMPLE XLVIII



72

Methyl-2-{*1R,3S*-3-[2-(3-Fluoro-phenyl)-5-methyl-oxazol-4-ylmethoxy]-cyclohexyloxymethyl}-6-methylbenzoate (**72**)

[0200] At room temperature, 50 mg of a 60% sodium hydride suspension and then 1.08 mmol of 2-(3-fluorophenyl)-4-iodomethyl-5-methyloxazole were added to a solution of 200 mg of methyl-2-(*1R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate (**47a**) in 5 ml of dimethylformamide. After the reaction was monitored by TLC to be complete (approximately one hour), methyl tert-butyl ether (~ 30 ml) was added, and the mixture was extracted with water. The organic phase was dried over magnesium sulfate, the solvents were removed under reduced pressure and the residue was purified by RP-HPLC. This gave **72** as a light-yellow oil. $C_{27}H_{30}FNO_5$ (467.54), MS(ESI): 468 ($M + H^+$).

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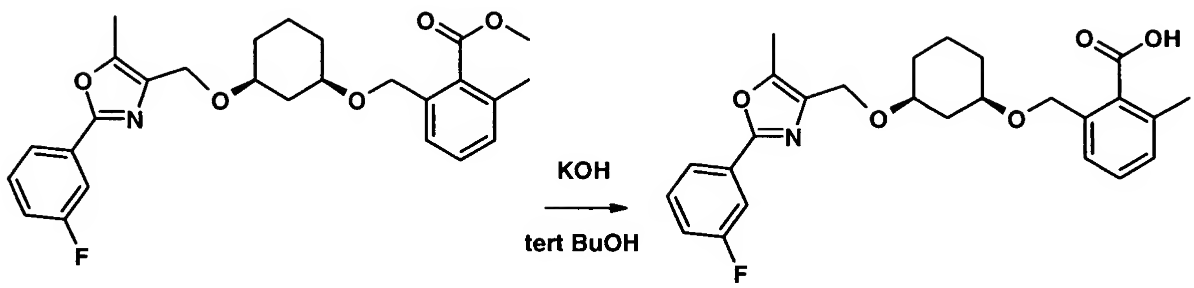

72 **73**

2-{*1R,3S*-3-[2-(3-Fluoro-phenyl)-5-methyl-oxazol-4-ylmethoxy]-cyclohexyloxymethyl}-6-methylbenzoic acid (**73**)

[0201] 100 mg of **72** were stirred in a mixture of 10 ml of tert-butanol and 1 ml of 10 N aqueous potassium hydroxide solution at 90°C. After he reaction was complete according to TLC (up to two days), the mixture was acidified with hydrochloric acid and extracted with ethyl acetate. The combined organic phases were dried over magnesium sulfate, the solvents were removed under reduced pressure and the residue was purified by RP-HPLC. This gave, as an amorphous solid, the product **73** of molecular weight 453.52 ($C_{26}H_{28}FNO_5$), MS(ESI): 454.35 (M + H^+).

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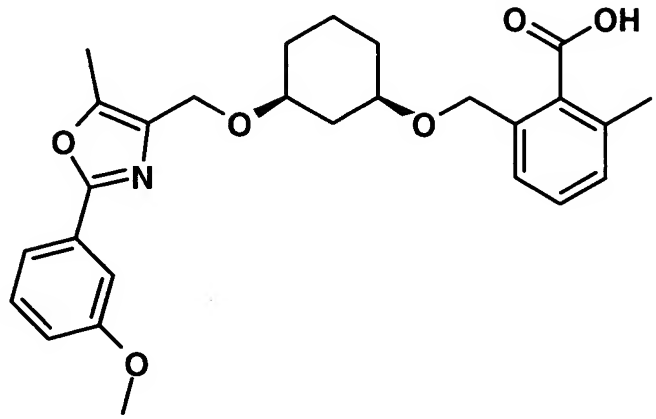
EXAMPLE IL



74

2-{*1R,3S*-3-[2-(3-Methoxy-phenyl)-5-methyl-oxazol-4-ylmethoxy]-cyclohexyloxymethyl}-6-methylbenzoic acid **(74)**

[0202] Methyl 2-(*1R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-methoxyphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **74** of molecular weight 465.55 ($C_{27}H_{31}NO_6$), MS(ESI): 466.37 (M + H^+).

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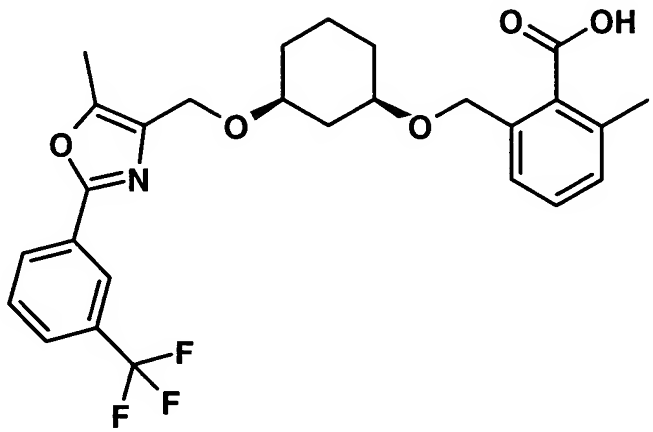
EXAMPLE L



75

2-{1*R,3S* -3-[2-(3-Trifluoromethylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid (**75)**

[0203] Methyl 2-(1*R,3S* -3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-trifluoromethylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **75** of molecular weight 503.52 ($C_{27}H_{28}F_3NO_5$), MS(ESI): 504.37 (M + H^+).

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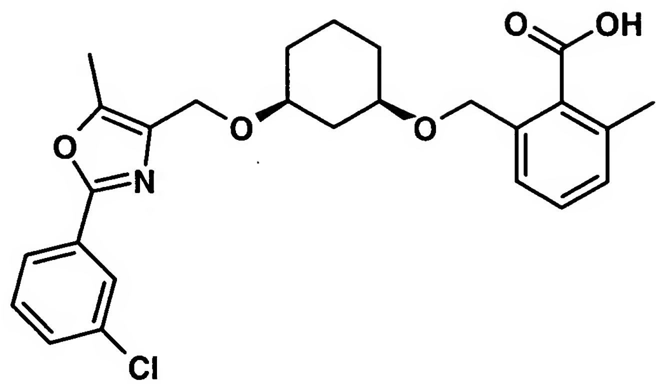
EXAMPLE LI



76

2-{1*R,3S*-3-[2-(3-Chlorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(76)**

[0204] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-chlorophenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **76** of molecular weight 469.97 ($C_{26}H_{28}ClNO_5$), MS(ESI): 470.43 ($M + H^+$).

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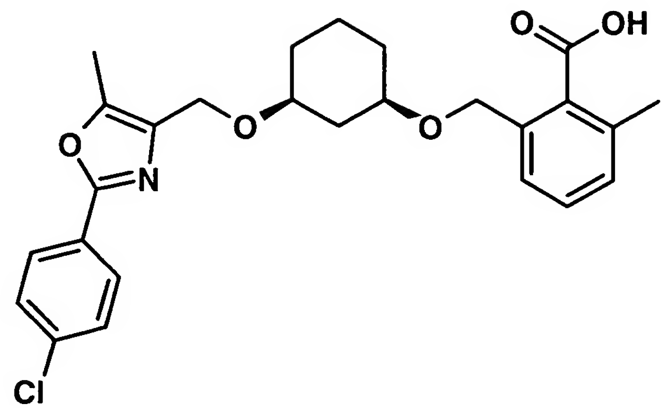
EXAMPLE LII



77

2-{1*R,3S*-3-[2-(4-Chlorophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid (**77**)

[0205] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-chlorophenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **77** of molecular weight 469.97 ($C_{26}H_{28}ClNO_5$), MS(ESI): 470.40 (M + H^+).

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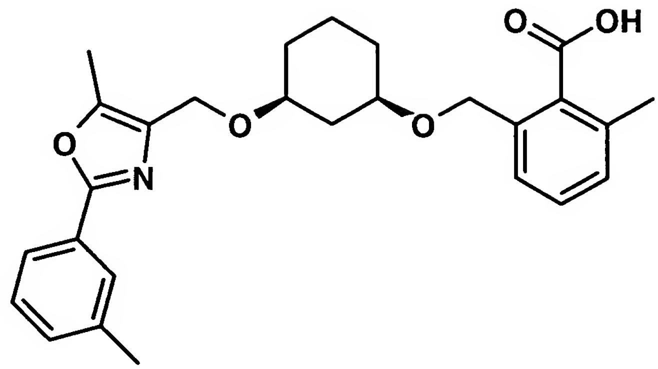
EXAMPLE LIII



78

2-{1*R,3S*-3-[2-(3-Methylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(78)**

[0206] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-methylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **78** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.53 (M + H^+).

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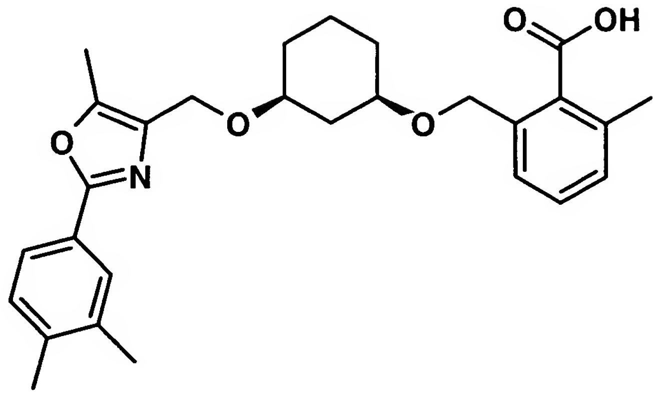
EXAMPLE LIV



79

2-{1*R*,3*S*-3-[2-(3,4-Dimethylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **79**

[0207] Methyl 2-(1*R*,3*S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3,4-dimethylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **79** of molecular weight 463.58 ($C_{28}H_{33}NO_5$), MS(ESI): 464.22 (M + H^+).

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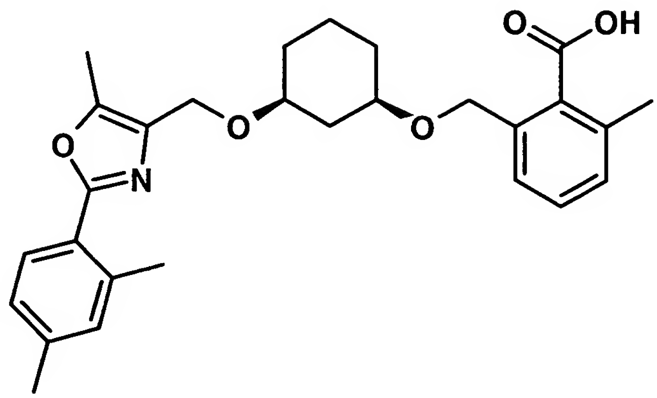
EXAMPLE LV



80

2-{1*R,3S*-3-[2-(2,4-Dimethylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid (**80)**

[0208] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(2,4-dimethylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **80** of molecular weight 463.58 ($C_{28}H_{33}NO_5$), MS(ESI): 464.22 (M + H^+).

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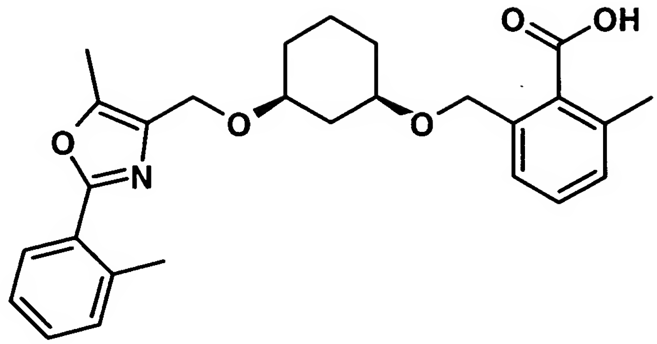
EXAMPLE LVI



81

2-{1*R,3S*-3-[2-(2-Methylphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid (**81)**

[0209] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(2-methylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **81** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.20 (M + H^+).

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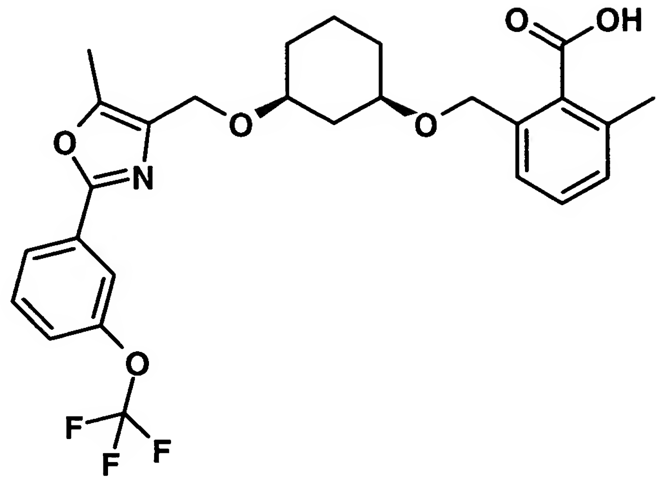
EXAMPLE LVII



82

2-{1*R*,3*S*-3-[2-(3-Trifluoromethoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid (**82**)

[0210] Methyl 2-(1*R*,3*S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-trifluoromethoxyphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **82** of molecular weight 519.52 ($C_{27}H_{28}F_3NO_6$), MS(ESI): 520.20 (M + H^+).

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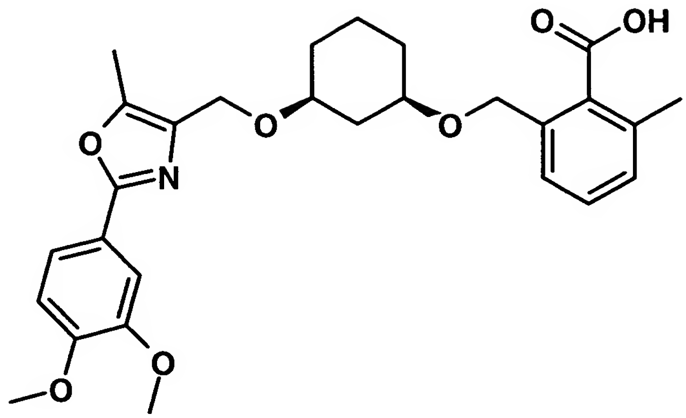
EXAMPLE LVIII



83

2-{1*R*,3*S*-3-[2-(3,4-Dimethoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(83)**

[0211] Methyl 2-(1*R*,3*S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3,4-dimethoxyphenyl)-4-iodomethyl-5-methyloxazol gave, under the same conditions as described for **72** and **73**, the product **83** of molecular weight 495.58 ($C_{28}H_{33}NO_7$), MS(ESI): 496.20 ($M + H^+$).

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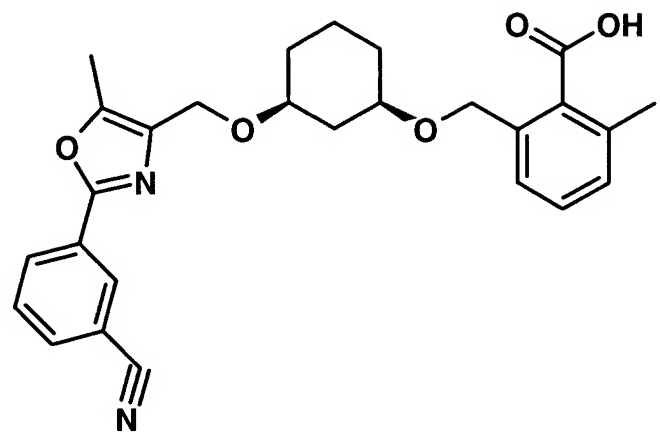
EXAMPLE LIX



84

2-{*1R,3S*-3-[2-(3-Cyanophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(84)**

[0212] 13 mg of 2-{*1R,3S*-3-[2-(3-bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid [prepared from Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-bromophenyl)-4-iodomethyl-5-methyloxazol under the same conditions as described for **72** and **73**] and 25 mg of zinc cyanide were dissolved in 5 ml of dimethylformamide. The reaction mixture was degassed and charged with argon, and 20 mg of tetrakistriphenylphosphinepalladium were added. The mixture was stirred at 100°C for 12 hours. After cooling to room temperature, water was added to the reaction mixture, which was then extracted with ethyl acetate. The combined organic phases were dried over magnesium sulfate, the solvents were removed under reduced pressure and the residue was purified by RP-HPLC. This gave **84** as an amorphous light-yellow solid. $C_{27}H_{28}N_2O_5$ (460.53), MS(ESI): 461.20 (M + H^+).

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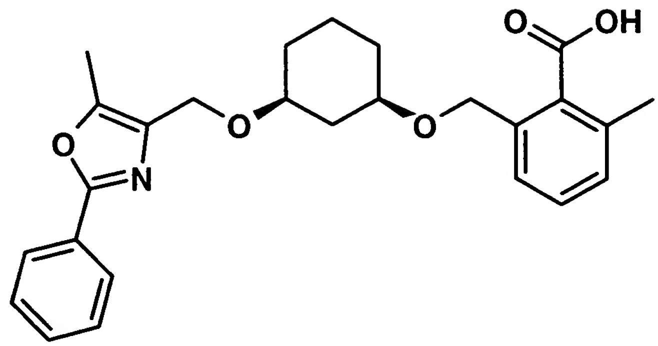
EXAMPLE LX



85

2-Methyl-6-[1*R*,3*S*-3-(5-methyl-2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **(85)**

[0213] Methyl 2-(1*R*,3*S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-phenyl-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **85** of molecular weight 435.52 ($C_{26}H_{29}NO_5$), MS(ESI): 436.32 (M + H^+).

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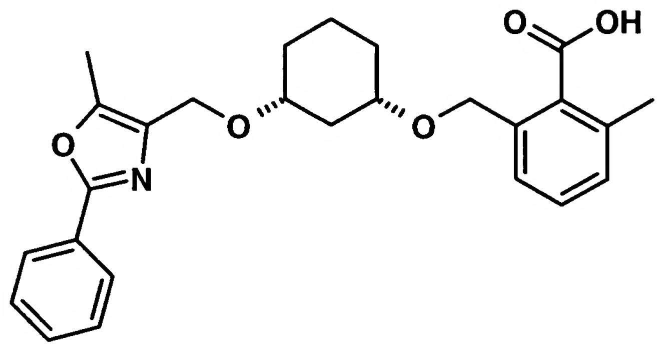
EXAMPLE LXI



86

2-Methyl-6-[1*S*,3*R*-3-(5-methyl-2-phenyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **(86)**

[0214] Methyl 2-(1*S*,3*R*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate (**47b**) and 2-phenyl-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **86** of molecular weight 435.52 ($C_{26}H_{29}NO_5$), MS(ESI): 436.32 (M + H^+).

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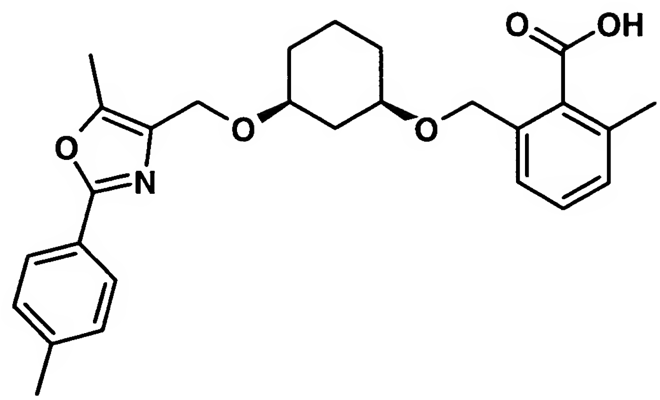
EXAMPLE LXII



87

2-Methyl-6-[1*R,3S*-3-(5-methyl-2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **(87)**

[0215] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and2-(4-methylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **87** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.36 (M + H^+).

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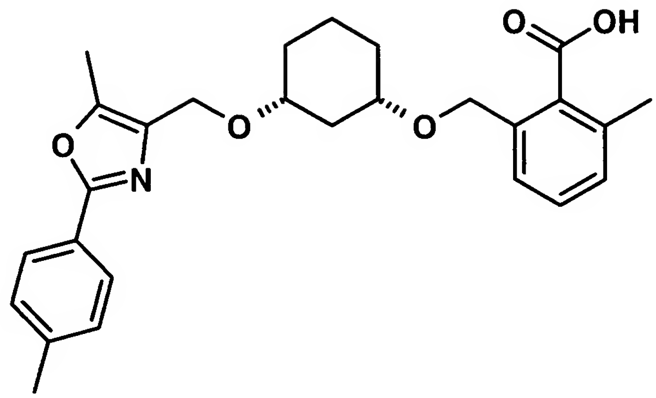
EXAMPLE LXIII



88

2-Methyl-6-[1*S*,*3R*-3-(5-methyl-2-p-tolyloxazol-4-ylmethoxy)cyclohexyloxymethyl]benzoic acid **(88)**

[0216] Methyl 2-(1S,*3R*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and2-(4-methylphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **88** of molecular weight 449.55 ($C_{27}H_{31}NO_5$), MS(ESI): 450.36 (M + H^+).

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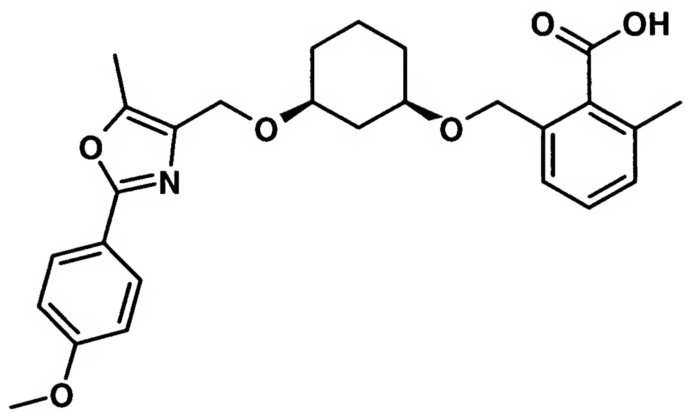
EXAMPLE LXIV



89

2-{1*R,3S*-3-[2-(4-Methoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(89)**

[0217] Methyl 2-(1*R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-methoxyphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **89** of molecular weight 465.55 ($C_{27}H_{31}NO_6$), MS(ESI): 466.37(M + H^+).

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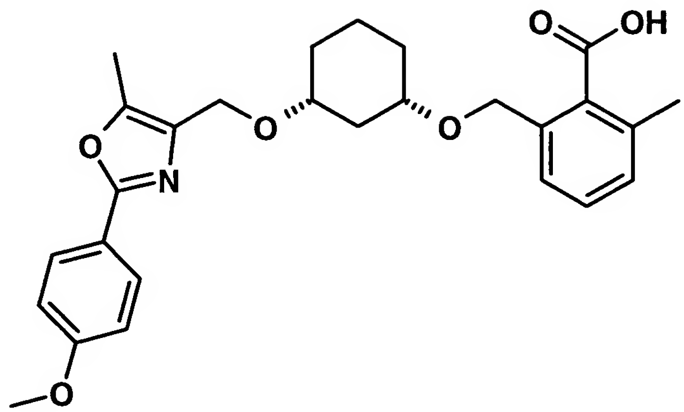
EXAMPLE LXV



90

2-{1*S,3R*-3-[2-(4-Methoxyphenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(90)**

[0218] Methyl 2-(1*S,3R*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-methoxyphenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **90** of molecular weight 465.55 ($C_{27}H_{31}NO_6$), MS(ESI): 466.37(M + H^+).

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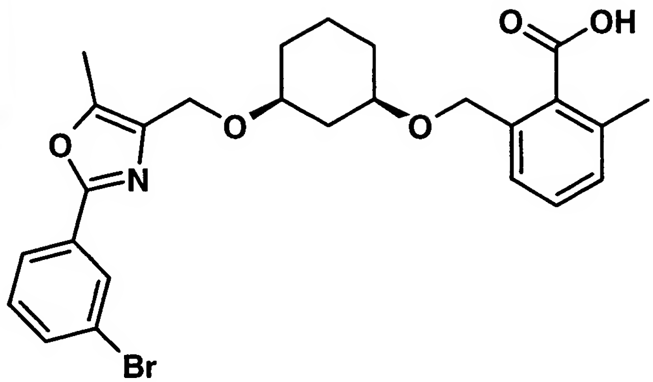
EXAMPLE LXVI



91

2-{*1R,3S*-3-[2-(3-Bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(91)**

[0219] Methyl 2-(*1R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(3-bromophenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **91** of molecular weight 514.42, ($C_{26}H_{28}BrNO_5$), MS(ESI): 514.30, 516.30 (M + H^+).

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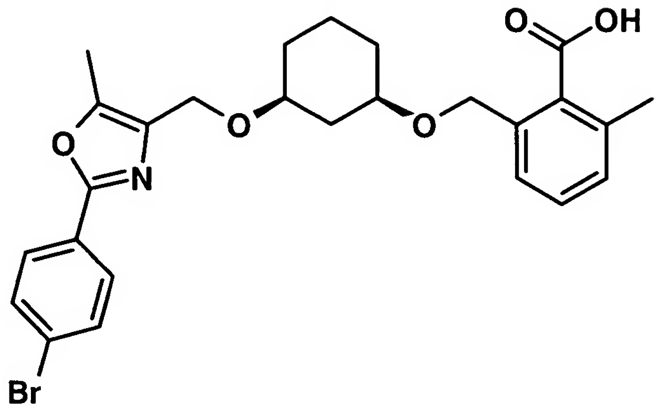
EXAMPLE LXVII



92

2-{*1R,3S*-3-[2-(4-Bromophenyl)-5-methyloxazol-4-ylmethoxy]cyclohexyloxymethyl}-6-methylbenzoic acid **(92)**

[0220] Methyl 2-(*1R,3S*-3-hydroxycyclohexyloxymethyl)-6-methylbenzoate and 2-(4-bromophenyl)-4-iodomethyl-5-methyloxazole gave, under the same conditions as described for **72** and **73**, the product **92** of molecular weight 514.42, ($C_{26}H_{28}BrNO_5$), MS(ESI): 514.29; 516.29 (M + H^+).

Example LXVIII

Process:

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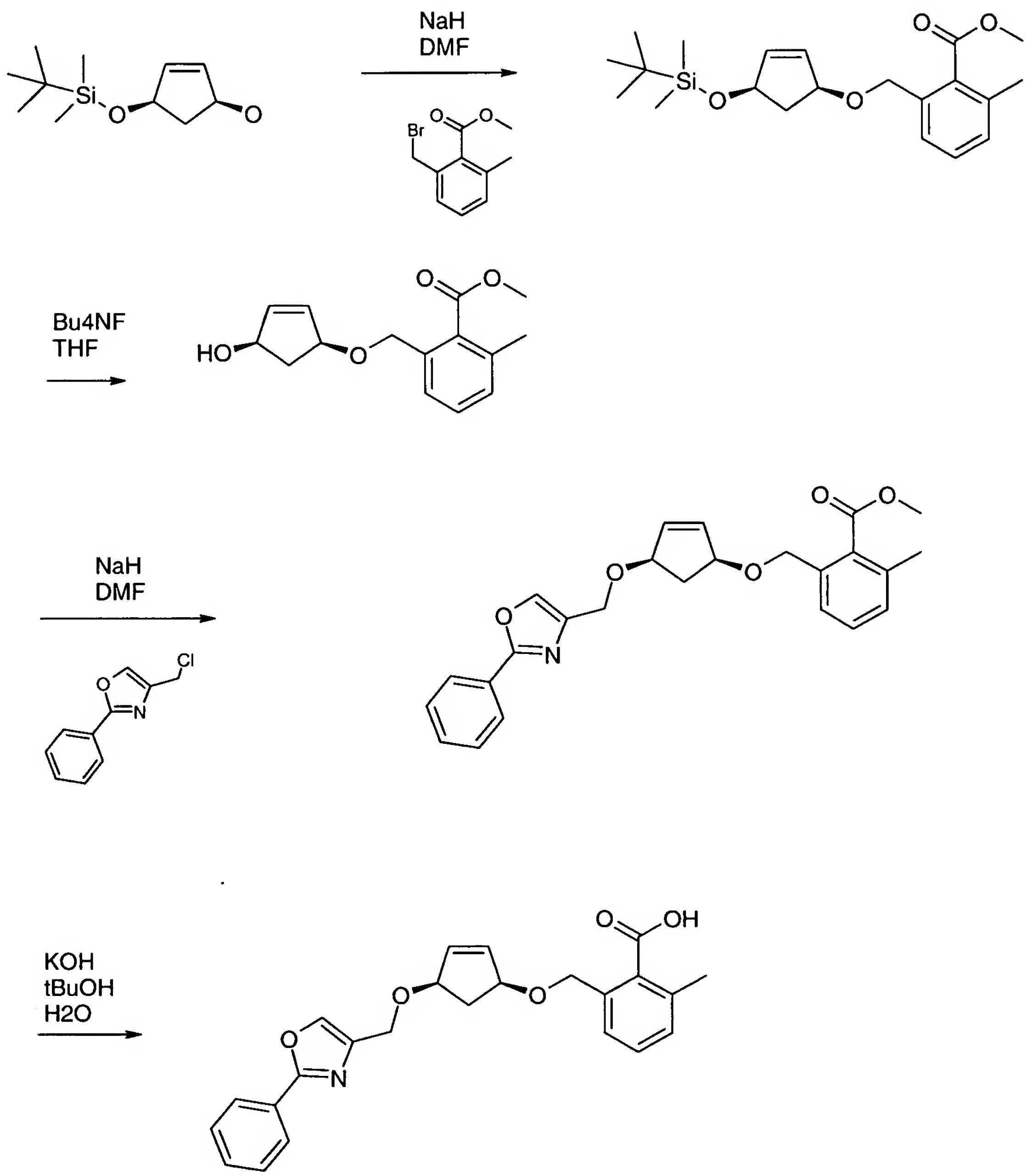

Methyl-[2-(*1S,4R*-4-tert-butyldimethylsilanyloxycyclopent-2-enyloxymethyl)-6-methyl] benzoate

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[0221] 8,2 g *1S,4R*-4-tert-Butyldimethylsilanyloxycyclopent-2-enol in 20 ml dry dimethyl formamide (DMF) are added dropwise under Argon atmosphere at 0°C to a suspension of 1,6 g 60% NaH in 12 ml dry DMF. Then 20 ml 60% (2-Bromomethyl-6-methy)-methyl-benzoate are added at 0°C. After the addition is completed the ice-bath is removed and the mixture is stirred at room temperature for 6 h. 200 ml Methyl-t-butyl-ether (MTBE) are then added and the organic phase is washed with 200 ml water and 200ml of saturated NaCl-solution. The organic layer is dried over MgSO4 and the solvents are removed. The remaining residue is purified by chromatography (SiO_2, n-heptane /MTBE 8:1 => 3:1), yielding the product Methyl-[2-(*1S,4R*-4-tert-butyldimethylsilanyloxycyclopent-2-enyloxymethyl)-6-methyl]benzoate as a yellow oil. C21H32O4Si (376,57), LCMS (ESI): 377 (MH^+).

Methyl-[2-(*1S,4R*-4-hydroxycyclopent-2-enyloxymethyl)-6-methyl]benzoate

[0222] To a solution of 2,3 g Methyl-[2-(*1S,4R*-4-tert-butyldimethylsilanyloxycyclopent-2-enyloxymethyl)-6-methyl]benzoate in 20 ml THF 10 ml 1M solution of tetrabutylammoniumfluoride in THF are added and stirred for 20 min at room temperature. The mixture is diluted with 100 ml MTBE and washed 3 times with 100 ml water, then with 50 ml of saturated NaCl-solution. The organic layer is dried over $MgSO_4$ and the solvent is removed. The remaining residue is purified by chromatography (SiO_2, n-heptane /MTBE 1:1), yielding the product

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Methyl-[2-(*1S,4R*-4-hydroxycyclopent-2-enyloxymethyl)-6-methyl]benzoate as a yellowish oil. C15H18O4 (262,31). LCMS (ESI): 263 (MH^+).

Methyl-{2-methyl-6-[1S,4R-4-(5-methyl-2-phenyloxazole-4-ylmethoxy)-cyclopent-2-enyloxymethyl]}benzoate

[0223] 300 mg Methyl-[2-(*1S,4R*-4-Hydroxycyclopent-2-enyloxymethyl)-6-methyl]benzoate, in 2 ml dry DMF are given dropwise under Argon atmosphere to a suspension of 55 mg 60% NaH in 3 ml dry DM. After 20 min of stirring at room temperature a solution of 320 mg 5-Methyl-2-phenyloxazole-4-ylmethylchloride in 1 ml DMF is added. The mixture is stirred for 90 min at room temperature, then 0.5 ml isopropanol are added followed by 20 ml MTBE. The solution is washed 3 times with 20 ml water, then with 20 ml of saturated NaCl-solution, the organic layer is dried over $MgSO_4$ and the solvents are removed. The remaining residue is purified by chromatography (SiO_2, n-heptane /MTBE 5:1). Fractions containing the product are collected and once more submitted to chromatography after removal of the solvents (SiO_2, n-heptane/ethylacetate 10:1), yielding the product Methyl-{2-methyl-6-[*1S,4R*-4-(5-methyl-2-phenyloxazole-4-ylmethoxy)-cyclopent-2-enyloxymethyl]}benzoate as a yellowish oil. C25H25NO5 (419,48). LCMS (ESI): 420 (MH^+).

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2-Methyl-6-[1S,4R-4-(5-methyl-2-phenyloxazole-4-ylmethoxy)-cyclopent-2-enyloxymethyl]-benzoic acid

[0224] 60 mg Methyl-{2-methyl-6-[*1S,4R*-4-(5-methyl-2-phenyloxazole-4-ylmethoxy)-cyclopent-2-enyloxymethyl]}benzoate in 1 ml 10 M aqueous KOH und 1 ml tert-butanol are stirred for 4 days at 100 °C. The mixture is diluted with 10 ml water and extracted 3 times with 10 ml ethylacetate. The combined organic layers are dried over MgSO4 and the solvents are removed. Purification of the remaining residue by HPLC yields 2-Methyl-6-[*1S,4R*-4-(5-methyl-2-phenyloxazole-4-ylmethoxy)-cyclopent-2-enyloxymethyl]-benzoic acid as a colorless oil. C24H23NO5 (405,45). LCMS (ESI): 406 (MH^+).

[0225] While the invention has been described in connection with certain preferred embodiments so that aspects thereof may be more fully understood and appreciated, it is not intended to limit the invention to these particular embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the scope of the invention as defined by the appended claims.

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